Operating instructions
EC controller

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1 Operating instructions

1.1 General instructions

To assure proper usage, we ask you to read these operating instructions carefully before installation and commissioning of the control device.

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This operating manual only refers to the control device described in this documentation and does not apply to any associated equipment / devices!

1.2 Safety instructions

Attention!

Only specialist personnel with specialist knowledge of electrical engineering are authorised to work on electrical components / assemblies!

Attention!

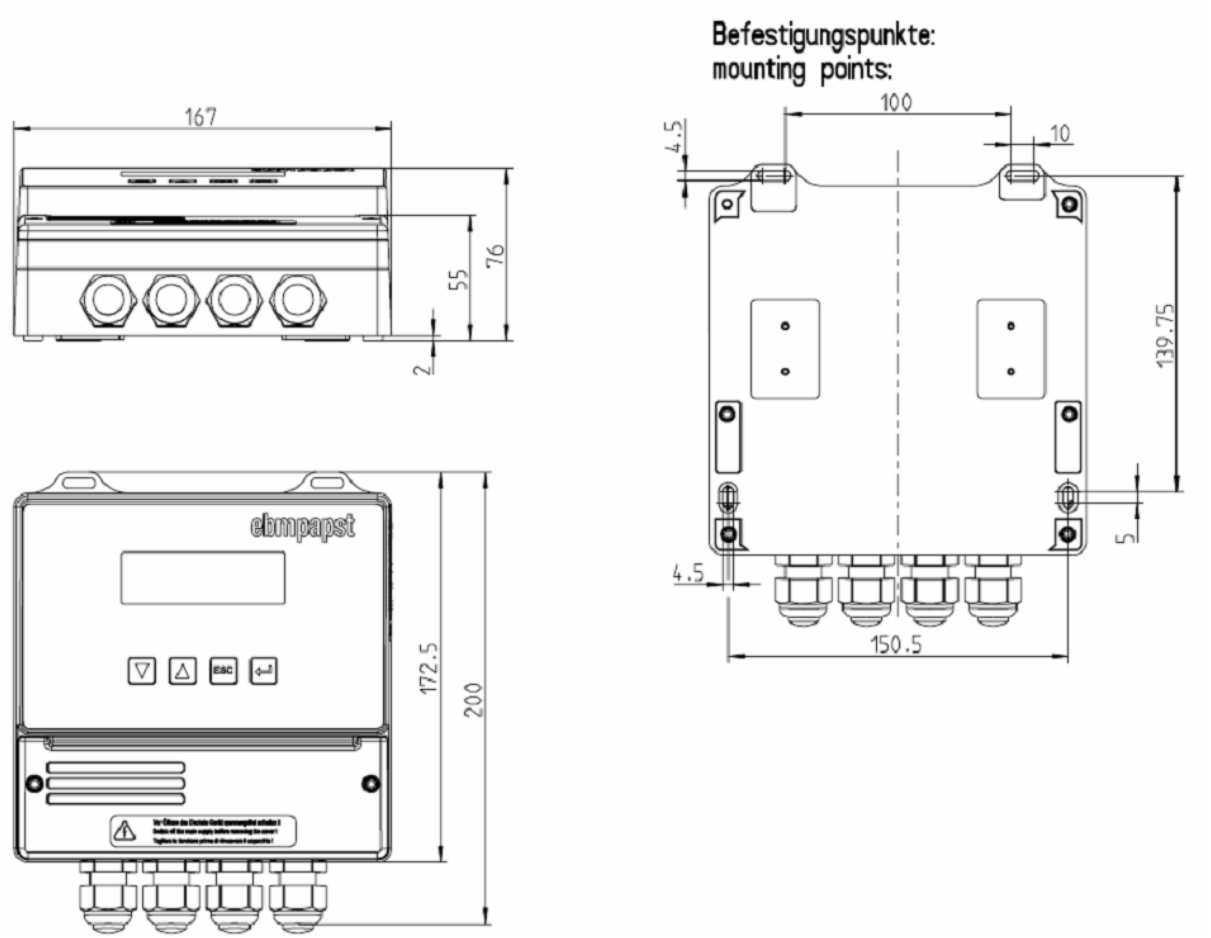
Before opening up the device, first isolate it from its power supply.

Danger from electrical current or voltage!

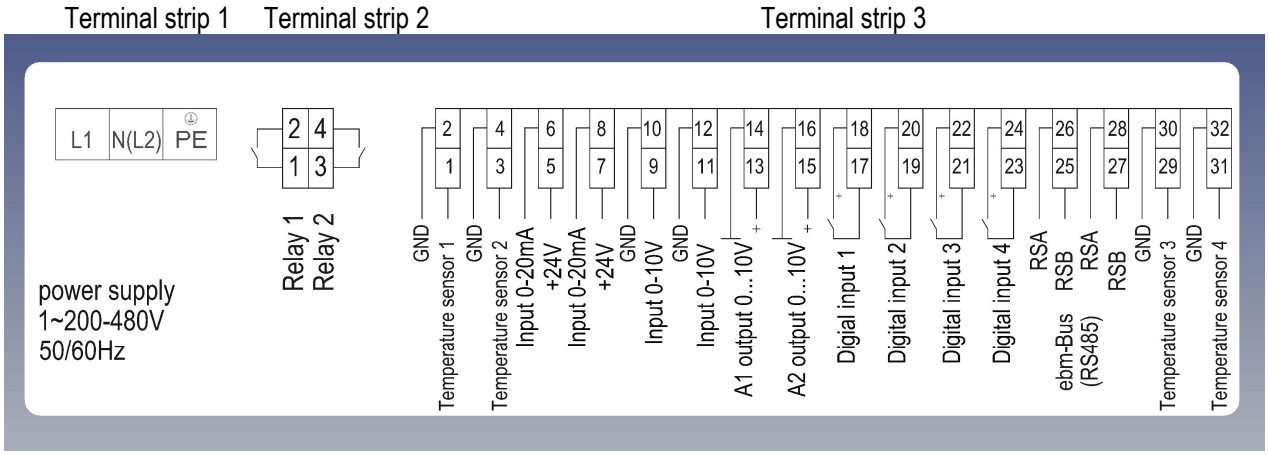
- All connections must be plugged while electrical power is switched off.
- Always ensure that no-one is able to come into contact with electrically live components while the equipment is in operation.
- The device can only be used while in perfect condition.

2 Layout / connection

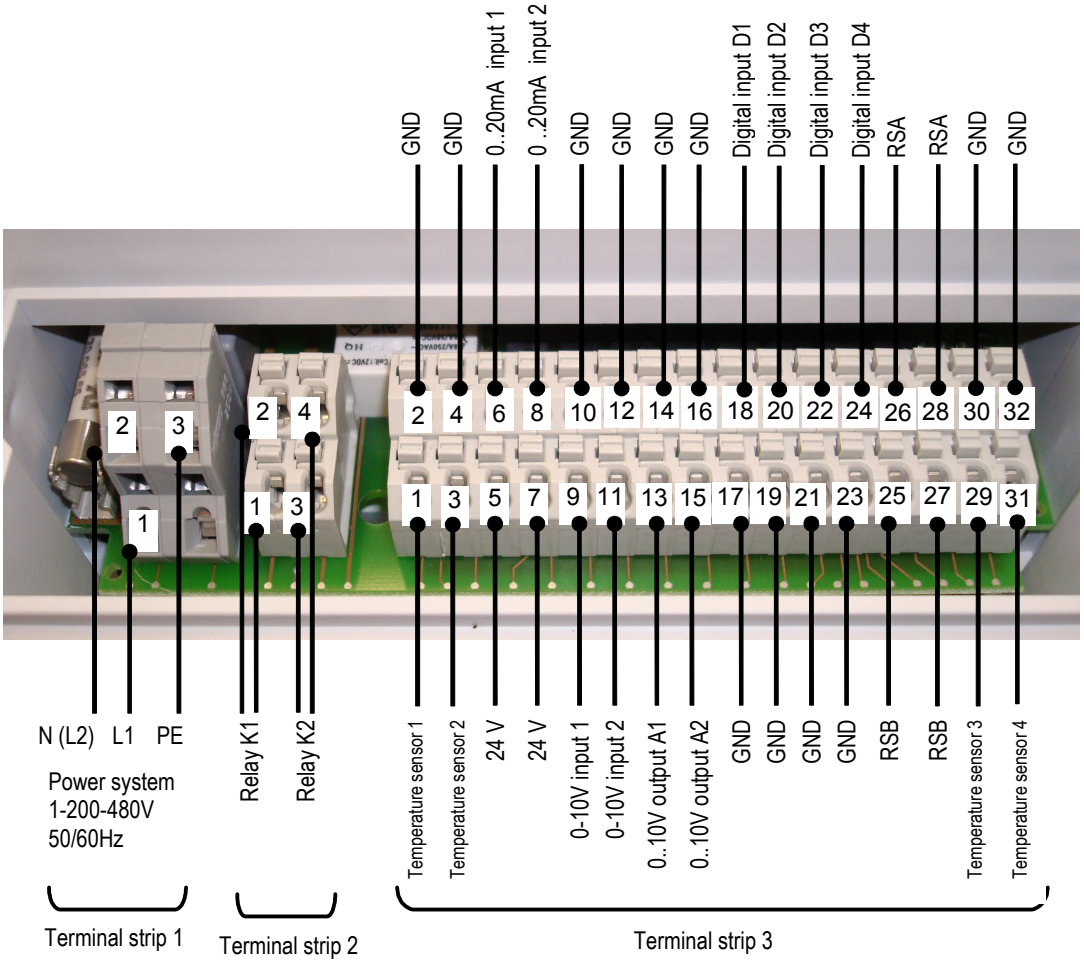
2.1 Mechanical layout



2.2 Connection terminals



The power supply of the control device is connected to terminal strip 1. Compatible cross-section: 0.08 – 2.5mm²
Two relay outputs are connected to terminal strip 2. Compatible cross-section: 0.5 – 1.5mm²
The remaining inputs and outputs are attached to terminal strip 3. Compatible cross-section: 0.5 – 1.5mm²



2.3 Supply voltage

Terminal designation:	Terminals 1-3 (terminal strip 1)
Nominal voltage:	1 ~ 200-480V
Frequency:	50/60Hz
Power input:	< 15VA

2.4 Inputs

2.4.1 PTC temperature sensors

Two temperature sensors can be connected.

Terminal designation:	Terminal strip 3; terminals 1-2 (temperature sensor 1)
	Terminal strip 3; terminals 3-4 (temperature sensor 2)
Permitted sensor:	KTY-10-6; R25 = 2kΩ

2.4.2 NTC temperature sensors

Two temperature sensors can be connected.

Terminal designation:	Terminal strip 3; terminals 29-30 (temperature sensor 3)
	Terminal strips 3; terminals 31-32 (temperature sensor 4)
Permitted sensors:	NTC 103AT; R25 = 10kΩ

2.4.3 Input 0/4..20mA

Two sensors can be connected to an 0..20mA- or 4..20mA output.

Terminal designation:	Terminal strip 3; terminals 6+10 (sensor 1)
	Terminal strip 3; terminals 8+12 (sensor 2)
Permitted sensors:	0..20mA
	4..20mA
Input resistor:	100Ω

2.4.4 Input 0..10V

Two sensors can be connected to an 0..10V output.

Terminal designation:	Terminal strip 3; terminals 9-10 (sensor 1)
	Terminal strip 3; terminals 11-12 (sensor 2)
Permitted sensor:	0..10V
Input resistor:	94kΩ

2.4.5 Digital inputs

For switchover between functions, 4 digital inputs are provided.

Terminal designation:	Terminal strip 3; terminals 17-18 (input 1)
(terminal strip 3)	Terminal strip 3; terminals 19-20 (input 2)
	Terminal strip 3; terminals 21-22 (input 3)
	Terminal strip 3; terminals 23-24 (input 4)
Switching:	NO switch
Input resistor:	14.7kΩ

2.5 Outputs

2.5.1 Output 0..10V

The device has two 0..10V outputs. Here, the control inputs (0..10V) of ebm-papst EC motors can be connected.

Terminal designation:	Terminal strip 3; terminals 13-14 (output 1) Terminal strip 3; terminals 15-16 (output 2)
Type of signal:	0..10V ± 3%
Max. output current:	10mA

2.5.2 Digital output (relay contact)

The control device has 2 digital outputs (relay contacts).
On the digital output, a reaction can be passed on to a connected unit.

Terminal designation:	Terminal strip 2; terminals 1-2 (output 1) Terminal strip 2; terminals 3-4 (output 2)
Type of signal:	Relay NO switch
Max. contact load:	2A / 250V AC

2.5.3 Power supply for sensors

The control device has two 24V outputs for supply of power to sensors.

Terminal designation:	Terminal strip 3; terminals 5+10 (output 1) Terminal strip 3; terminals 7+12 (output 2)
Type of signal:	24V ± 20%
Max. output current:	120mA

2.6 Bus connection

The control device has a bus connection for communication with ebm-papst motors
Each of the two connections, RSB and RSA, are connected internally

Terminal designation:	Terminal strip 3; terminals 25,27 (RSB)+ 26,28 (RSA)
Type of signal:	RS485, MODBUS RTU

3 Operation

3.1 Controls

3.1.1 Display

For display purposes and to change values, the control device has a screen display:

Type: LCD display
STN blue mode
negative screen display

Size: 4 lines, each of 20 characters

The display is menu-driven. The various menus and their arrangement are described in Chapter 3.2 Menu guide.
The display switches to standby mode after 4 minutes. Press any key to reactivate it.

3.1.2 Input keys

The control device has 4 input keys for selecting the various display menu item and to alter values:

- Key ▼ - "Lower"
- Key ▲ - "Higher"
- ESC key - "Exit"
- OK key - "Accept"

3.1.3 Function of the input keys

These various menus are structured into several levels. A distinction is made between

- "Headings" - these menus have sub-menu items and no values are displayed
- "Values" - these are located on the lowest level of the menu; values can be displayed and edited here

To change between these individual menu items and to edit values, the 4 input keys are used (see 3.1.2). The structure of these menus is described beginning in 3.2.

The setting options are only touched on briefly here, then described in greater detail in the following Chapters.

The 4 input keys (see 3.1.2) have 2 different functions:

- Switchover - changing over between the individual menu items
- Input - editing values

With the "Headings" menus, there is only the "Switchover" function.
In the menus at the lowest level of "Values", both functions exist:
With the "Input" function, the displayed value flashes.
With the "Switchover" function, the value is displayed continuously.

"Switchover" function:

- Key ▼ : Move to next menu item on the same level
- Key ▲ : Move to previous menu item on the same level
- ESC key : Move to higher-level menu (one level higher)
- OK key : in "Headings" menu: move to lower-level menu (one level lower)
  in "Values" menu: enable input function

"*Input" function:*

- Key ▼ : Reduce value by 1 stage
- Key ▲ : Increase value by 1 stage
- ESC key : Terminate input function (do not accept new value)
- OK key : Accept value; terminate input function

Fast forward:

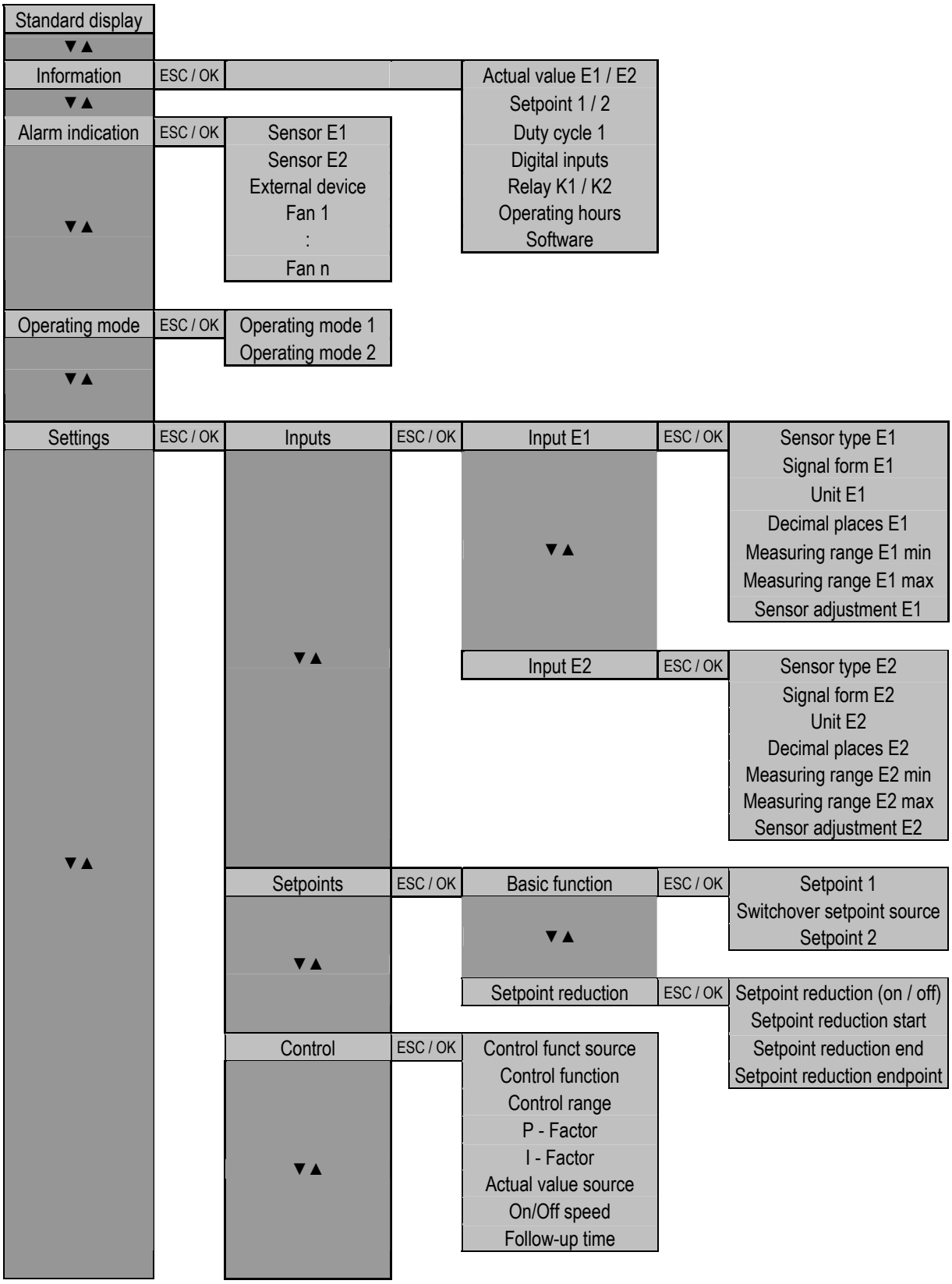
The value range for input can comprise up to 20,000 stages. For this reason, the ▼ and ▲ keys have a Fast Forward function:

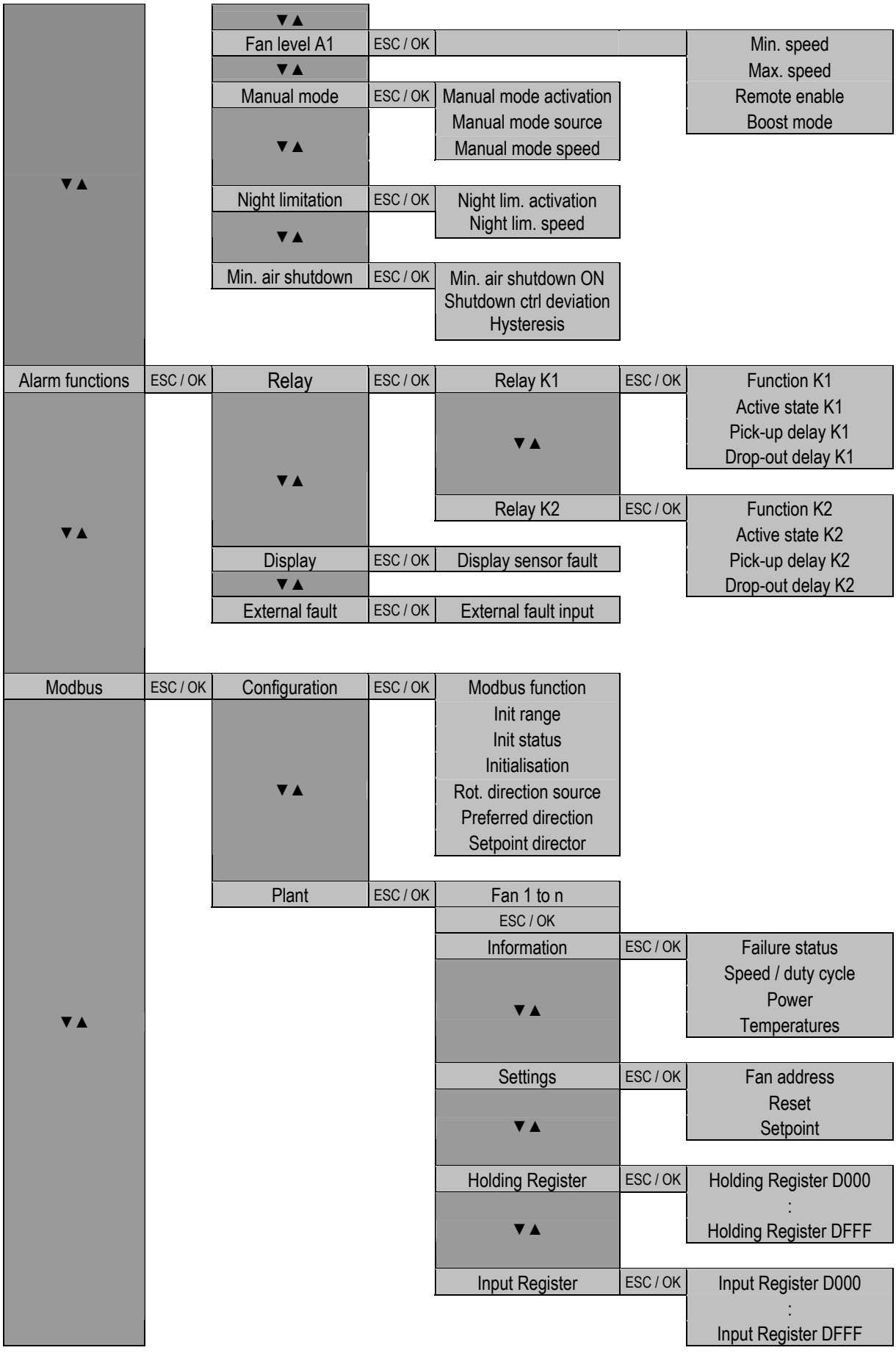
If the keys are pressed and held down for less than 1 second, the value changes once by a single stage.
If the keys are held down for longer than 1 second, the value changes at a speed of 40 stages per second.
If the keys are held down for longer than 6 seconds, the value changes at a speed of 200 stages per second.

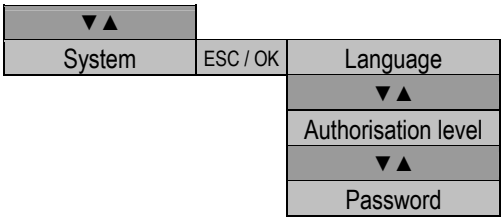
This means that any value across the entire range can be set within approx. 100 seconds.

3.2 Menu guidance

3.2.1 Overview




▼▲
Fan level A1
ESC / OK
Min. speed
Max. speed
Remote enable
Boost mode
Manual mode
Manual mode activation
Manual mode source
Manual mode speed
Night limitation
Night lim. activation
Night lim. speed
Min. air shutdown
Min. air shutdown ON
Shutdown ctrl deviation
Hysteresis
Alarm functions
Relay
Relay K1
Function K1
Active state K1
Pick-up delay K1
Drop-out delay K1
Relay K2
Function K2
Active state K2
Pick-up delay K2
Drop-out delay K2
Display
Display sensor fault
External fault
External fault input
Modbus
Configuration
Modbus function
Init range
Init status
Initialisation
Rot. direction source
Preferred direction
Setpoint director
Plant
Fan 1 to n
Information
Failure status
Speed / duty cycle
Power
Temperatures
Settings
Fan address
Reset
Setpoint
Holding Register
Holding Register D000
:
Holding Register DFFF
Input Register
Input Register D000
:
Input Register DFFF



3.2.2 Main menu

```
   ebmpapst
EC Controller
```

After the device has been switched on, the first thing to appear on screen for 5 seconds is information about the manufacturer and the device.

Then the 1st point (standard display) on the main menu is displayed:

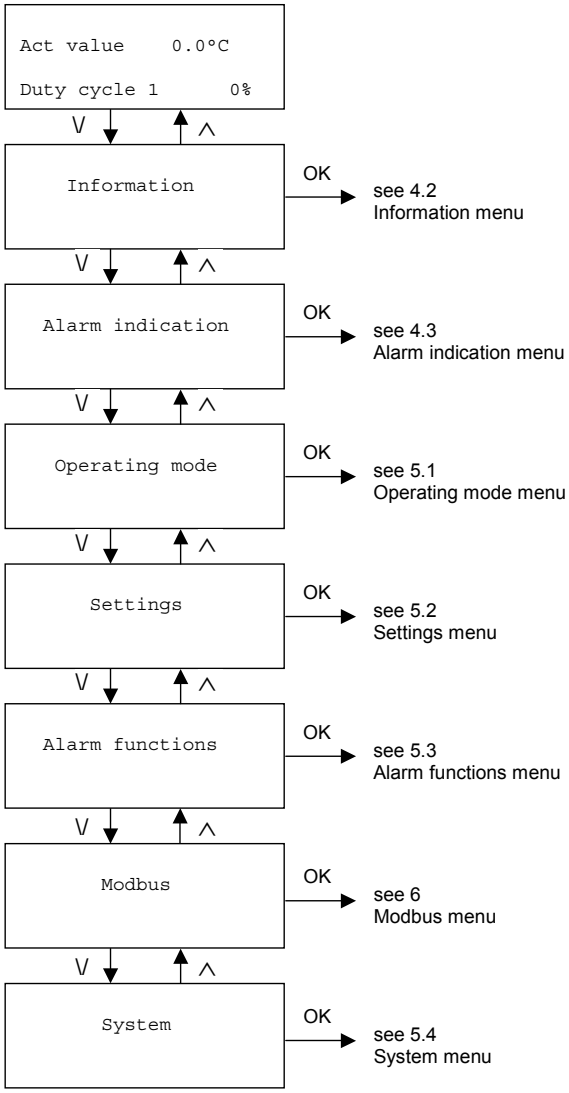
```
Act value    24.0°C

Duty cycle A1      0%
```

Here the actual value of the sensor and the duty cycle on output A1 are displayed. The standard display does not have any further sub-menus and no input options. The OK and ESC keys therefore do not function.

If the control device detects an error and this is also released to the display unit, the standard display appears in alternation with the error display.
This alternating display only exists in this menu item!

By pressing the ▼ key, other points on the main menu can be called up:

Overview of main menu:



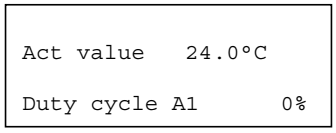
4 Displaying values

The first 3 menu items of the main menu ("Standard display", "Information", "Alarm indication") are used to display the following:

- Input and output signals on the control device
- Important values for the control (taken from "Settings" menu)
- Fault signals

There is no input option in these menus

4.1 Standard display

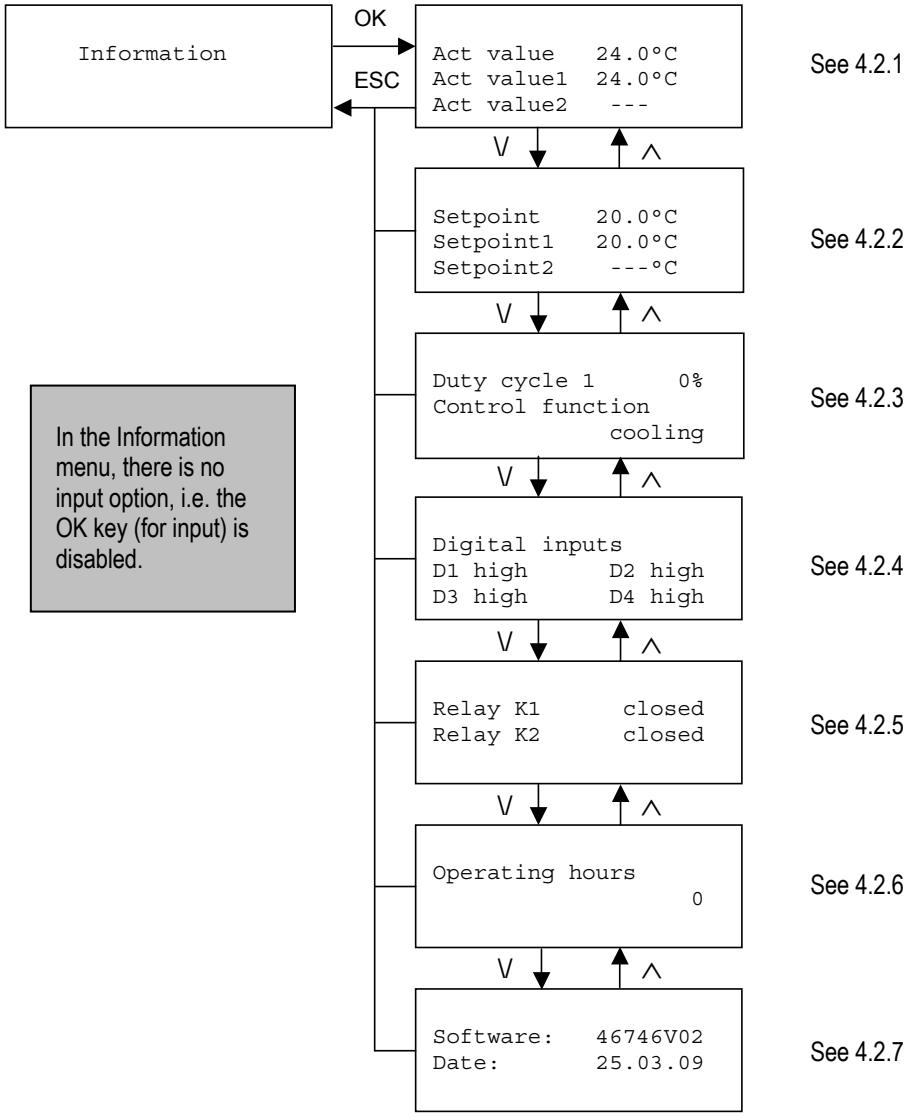


Actual value E1:
Here the value is displayed which the sensor provides from the selected input.
The input is selected via the menus Settings > Control > Actual value source and
Settings > Inputs > Input E1/2 > Signal form E1/2
(For details, refer to 5.2.3.5, 5.2.1.2).

Duty Cycle A1:
Here the duty cycle at output A1 is displayed.
0% indicates an output voltage of 0V
100% indicates an output voltage of 10V

If the control device detects a fault, this is displayed in alternation with the standard display.
The fault display corresponds to the form shown in the "Alarm indication" menu (see 4.3).

4.2 Information Menu



In the Information menu, there is no input option, i.e. the OK key (for input) is disabled.

4.2.1 Actual values

Information > Act values

```
Act value   24.0°C
Act value1  24.0°C
Act value2  23.2°C
```

Actual value E1:

Select input E1 via the menu Settings > Inputs > Input E1 > Signal form E1 (for details, refer to 5.2.1.2).
Here the value is displayed which the sensor provides from the selected input.

If the signal form for the "OFF" value is selected, the display "---" appears here.

Actual value E2:

Select input E2 via the menu Settings > Inputs > Input E2 > Signal form E2 (for details, refer to 5.2.1.2).
Here the value is displayed which the sensor provides from the selected input.

If the signal form for the "OFF" value is selected, the display "---" appears here.

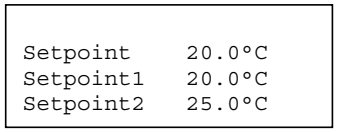
Actual value:

Select via menu Settings > Control > Actual value source whether to use the actual value at Input E1 or at Input E2 as your actual value (for details, refer to 5.2.3.5).
Depending on the setting of this parameter, the value from "Actual value E1" or "Actual value E2" is copied to the "Actual value".

This actual value then forms the actual value for the controller.
The displayed value is the same as the one on the standard display.

4.2.2 Setpoints

» Information > Setpoints



Setpoint 1:

Here, the setpoint configured in this menu sequence is displayed: Settings > Setpoints > Basic function > Setpoint 1.

Setpoint 2:

Here, the setpoint configured in this menu sequence is displayed: Settings > Setpoints > Basic function > Setpoint 2.
If the switchover to the 2nd setpoint has been disabled (Settings > Setpoints > Basic function > Switchover between setpoints 1/2), no value (---) is displayed here.

Setpoint:

Here the setpoint for the control device is displayed.
In the basic function, this corresponds to Setpoint 1 or to Setpoint 2
Selection is made through parameter Settings > Setpoints > Basic function > Switchover between setpoints 1/2 and the status of the digital input selected here.
(For details, refer to 5.2.2.1).

In the extended function, the parameters Settings > Setpoints > Setpoint reduction depending on E2 are also incorporated in the calculation of the setpoint.
In this case, the setpoint can differ from Setpoint 1 and Setpoint 2 (for details, refer to 5.2.2.2)

4.2.3 Controller data

» Information > Controller data

```
Duty cycle 1      0%
Control function
             cooling
```

Duty Cycle A1:

Here the duty cycle at output A1 is displayed.

0% indicates an output voltage of 0V
100% indicates an output voltage of 10V

The displayed value is the same as the one on the standard display.

Control function:

This is where the currently used control function is displayed. This is dependent on the following parameters:

- Settings > Control > Control funct source
- for internal: Settings > Control > Control function
- otherwise: Status at selected digital input

Possible values:

Heating:	Control function positive, i.e. control deviation = Setpoint - Actual value
Cooling:	Control function negative, i.e. control deviation = Actual value - Setpoint

4.2.4 Digital inputs

» Information > Digital inputs

```
Digital inputs
D1 high      D2 low
D3 low       D4 high
```

The status of digital inputs D1, D2, D3 and D4 is displayed.

Possible values:

Low	: Digital input is bridged to GND;	i.e. contact at input is closed
High	: Digital input is open;	i.e. contact at input is open

4.2.5 Relay

» Information > Relays

```
Relay K1      Closed
Relay K2      Closed
```

Relay K1:

The status of relay K1 is displayed:

Possible values:

Opened	: Relay dropped;	contact opened
Closed	: Relay raised;	contact closed

Relay K2:

The status of relay K2 is displayed:

Possible values:

Opened	: Relay dropped;	contact opened
Closed	: Relay raised;	contact closed

4.2.6 Operating hours counter

» Information > Operating hours counter

```
Operating hours
                  0
```

The number of full hours is displayed during which the control device was switched on.
Only full hours are counted. If the control device is switched off, any incomplete hours are discounted.

4.2.7 Software Version

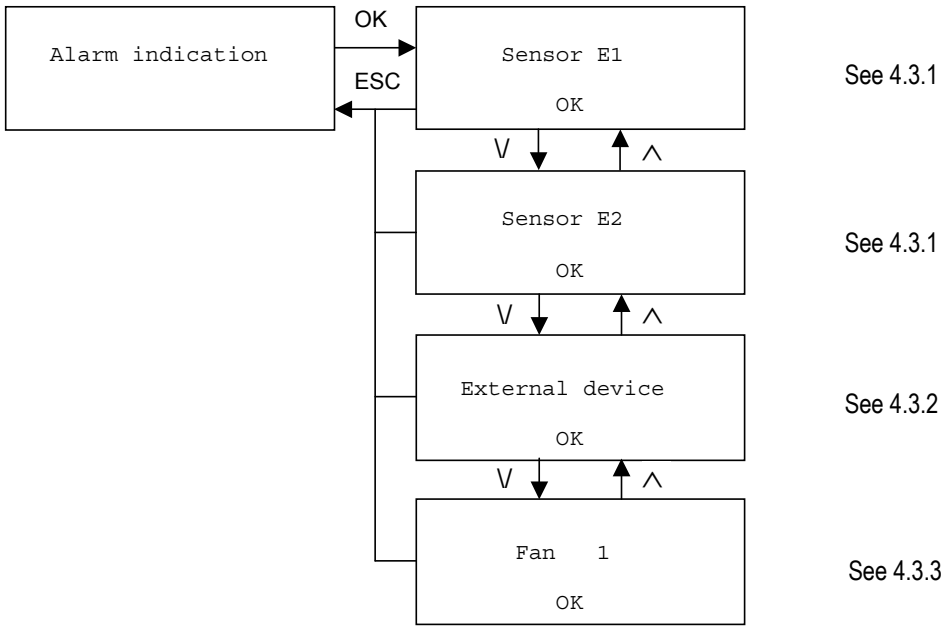
» Information > Software version

```
Software:   46746V02
Date:       25.03.09
```

Displays the software version with which the control device is running.
The second line contains the relevant release date for this software date.

4.3 Alarm indication menu

In the Alarm indication menu, there is no input option, i.e. the OK key (for input) is disabled. The Alarm indication alternates in menu item "Standard display" with the standard display if an alarm is present and has been released to the display (see 4.1).



The "Fan" menu item is displayed for each fan found in the initialisation via Modbus (see 6.1.2). The number of menu items depends on the number of fans found (i.e. up to 32). For differentiation, the specific fan address is specified. If no fan has been found, this menu item is omitted.
For the sake of simplicity, only one menu item is displayed here.

4.3.1 Sensors

⋙ Alarm indication > Sensor E1

Sensor E1	Sensor E2
OK	OK

Sensors:

The status of the sensor at Input E1 or at Input E2 and any possible errors occurring on the sensor are displayed.

Possible values:

OK:	No error
Cable break:	sensor is not connected
Short circuit:	Short circuit on sensor

Errors can be recorded for signal forms "PTC", "NTC" and "4..20mA" only.
With other signal forms, the full range of values is valid.

With actual values smaller than the minimum value to be recorded by the sensor, this display appears:

Short circuit.

With actual values larger than the maximum value to be recorded by the sensor, this display appears:

Cable break.

4.3.2 External device

⋙ Alarm indication > External device

External device
OK

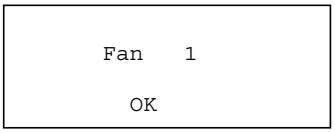
The status is displayed for the external device whose fault output is connected to the selected digital input on the control device.
The digital input is selected via menu Alarm functions > External fault > Input
(For details, refer to 5.3.3).

Possible values:

OK	: No fault on the external device
Fault	: Fault on the external device

4.3.3 Fan

Alarm indication > Fan



The status is displayed for each fan found in the initialisation via Modbus (see 6.1.2).
The number of menu items depends on the number of fans found (i.e. up to 32). For differentiation, the specific fan address is specified. If no fan has been found, this display is omitted.

Possible values:

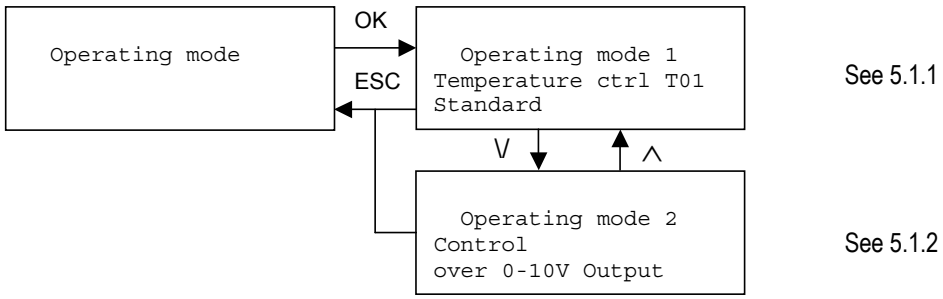
• OK	
• Phase failure	
• Power module overheated	
• Internal comm error	(communication error between the microcontrollers in the fan)
• Motor overheated	
• Hall sensor failure	
• Locked motor	
• Electronics overheated	
• Overvoltage	
• Undervoltage	
• Reversed operation	(external drive in reversed operation at high speed for longer period)
• Not connected	(RS-485 connection between control device and fan is interrupted)

If an error is displayed without further information ("Error No. ..."), it was not yet defined at the time the control device was developed and thus cannot be output in plain text.
If this display appears, refer to the corresponding "Modbus parameter specification" of the fan to determine the cause of the error.

5 Configuring values

The menu items "Operating mode", "Settings", "Alarm functions" and "System" of the main menu contain values that are both displayed and modified. These are parameters that can be used to configure the function of the control device.

5.1 Operating mode menu



Easy installation of the control device is possible by selecting preprogrammed operating modes (for additional information, refer to 7.)

When selecting an application in the Operating mode 1 menu, the "Settings" and "Alarm functions" menus are configured automatically, i.e. all values of these menus are overwritten with the default values.

When selecting an application in the Operating mode 2 menu, the "Modbus" menu is configured automatically, i.e. all values of this menu are overwritten with the default values.

The factory pre-settings for each operating mode are based on experiential figures compiled over many years and suitable for many different applications. In exceptional cases, these can be adapted individually by changing the numbers manually in the "Settings" and "Alarm functions" or "Modbus" menus.

If, in the Operating mode 1 or Operating mode 2 menu, an input is confirmed with OK, another confirmation prompt appears before the value is taken over:

```
Change mode?
All values will be
overwritten!     NO
```

If the value is changed from "NO" to "YES" during the security check and is confirmed with the OK key, all parameters containing the standard value for this operating mode are overwritten!

By cancelling with the ESC key or by entering "NO", it is still possible to cancel changes to the operating mode at this point.

5.1.1 Operating mode 1

Operating mode > Operating mode 1

```
  Operating mode 1
Temperature ctrl T01
Standard
```

Possible operating modes:

T01:	Temperature control, standard
T02:	Temperature control, NTC
P01:	Pressure control, ventilation systems
P02:	Pressure control, ambient temperature-compensated
C01:	Pressure control, condensers
C02:	Pressure control, 2-circuit condensers

The following tables show how the device is configured for the preset operating modes:

Operating mode	T01	T02	P01	P02	
Sensor type E1	Temperature sensor KTY 10-6	Temperature sensor NTC 103AT	Pressure sensor 0..500Pa	Pressure sensor 0..500Pa	
Signal form E1	PTC	NTC	0-10V	0-10V	
Unit E1	°C	°C	Pa	Pa	
Decimal places E1	1	1	0	0	
Measuring range E1 min	-30.0	-30.0	0	0	
Measuring range E1 max	70.0	90.0	500	500	
Sensor comparison check E1	0.0	0.0	0	0	
Sensor type E2	No sensor	No sensor	No sensor	Temperature sensor KTY 10-6	
Signal form E2	OFF	OFF	OFF	PTC	
Unit E2	Pa	Pa	Pa	°C	
Decimal places E2	0	0	0	1	
Measuring range E2 min	0	0	0	-30.0	
Measuring range E2 max	1000	1000	1000	70.0	
Sensor comparison check E2	0	0	0	0.0	
Setpoint 1	20.0	20.0	250	250	
Switchover, setpoint 1/2	OFF	OFF	OFF	OFF	
Setpoint 2	20.0	20.0	250	250	
Setpoint reduction	OFF	OFF	OFF	ON	
Setpoint reduct. Start	15	15	15	15.0	
Setpoint reduct. End	-15	-15	-15	-15.0	
Setpoint at endpoint	70.0	70.0	70	70	
Control funct source	Internal	Internal	Internal	Internal	
Control function	Cooling	Cooling	Heating	Heating	
Control range	5.0	5.0	1000	1000	
P - Factor	2000%	2400%	50%	50%	
I - Factor	0.0%	0.0%	5.0%	5.0%	
Actual value source	E1	E1	E1	E1	
On/Off speed	0%	0%	12%	12%	
Follow-up time	0s	0s	20s	20s	
Min. speed	0%	0%	0%	0%	
Max. speed	100%	100%	100%	100%	
Remote enable	OFF	OFF	OFF	OFF	
Boost mode	OFF	OFF	OFF	OFF	
Manual mode activation	OFF	OFF	OFF	OFF	
Manual mode source	Internal	Internal	Internal	Internal	
Man. mode Duty Cycle	0%	0%	0%	0%	
Night limitation active	OFF	OFF	OFF	OFF	
Max. night duty cycle	100%	100%	100%	100%	
Minimum air shutdown	OFF	OFF	OFF	OFF	
Shutdown control deviation	0.0	0.0	0	0	
Hysteresis	0.0	0.0	0	0	
Function K1	All faults	All faults	All faults	All faults	
Active state K1	opened	opened	opened	opened	
On-delay K1	0s	0s	0s	0s	
Drop-out delay K1	0s	0s	0s	0s	
Function K2	Off / static	Off / static	Off / static	Off / static	
Active state K2	opened	opened	opened	opened	
On-delay K2	0s	0s	0s	0s	
Drop-out delay K2	0s	0s	0s	0s	
Screen display sensor fault	OFF	OFF	OFF	OFF	
External fault input	OFF	OFF	OFF	OFF	

Operating mode	C01	C02			
Sensor type E1	Pressure sensor 0..30bar	Pressure sensor 0..30bar			
Signal form E1	4..20mA	4..20mA			
Unit E1	bar	bar			
Decimal places E1	2	2			
Measuring range E1 min	0	0			
Measuring range E1 max	30.00	30.00			
Sensor comparison check E1	0	0			
Sensor type E2	No sensor	Pressure sensor 0..30bar			
Signal form E2	OFF	4..20mA			
Unit E2	Pa	bar			
Decimal places E2	0	2			
Measuring range E2 min	0	0			
Measuring range E2 max	1000	30.00			
Sensor comparison check E2	0	0			
Setpoint 1	12.00	12.00			
Switchover, setpoint 1/2	OFF	OFF			
Setpoint 2	12.00	12.00			
Setpoint reduction	OFF	OFF			
Setpoint reduct. Start	15	15.00			
Setpoint reduct. End	-15	-15.00			
Setpoint at endpoint	70.00	70.00			
Control funct source	Internal	Internal			
Control function	Cooling	Cooling			
Control range	5.00	5.00			
P - Factor	600%	600%			
I - Factor	0.0%	0.0%			
Actual value source	E1	Max (E1; E2)			
On/Off speed	0%	0%			
Follow-up time	0s	0s			
Min. speed	0%	0%			
Max. speed	100%	100%			
Remote enable	OFF	OFF			
Boost mode	OFF	OFF			
Manual mode activation	OFF	OFF			
Manual mode source	Internal	Internal			
Man. mode Duty Cycle	0%	0%			
Night limitation active	OFF	OFF			
Max. night duty cycle	100%	100%			
Minimum air shutdown	OFF	OFF			
Shutdown control deviation	0.00	0.00			
Hysteresis	0.00	0.00			
Function K1	All faults	All faults			
Active state K1	opened	opened			
On-delay K1	0s	0s			
Drop-out delay K1	0s	0s			
Function K2	Off / static	Off / static			
Active state K2	opened	opened			
On-delay K2	0s	0s			
Drop-out delay K2	0s	0s			
Screen display sensor fault	OFF	OFF			
External fault input	OFF	OFF			

5.1.2 Operating mode 2

Operating mode > Operating mode 2

```
  Operating mode 2
Control
over 0-10V output
```

Possible operating modes:

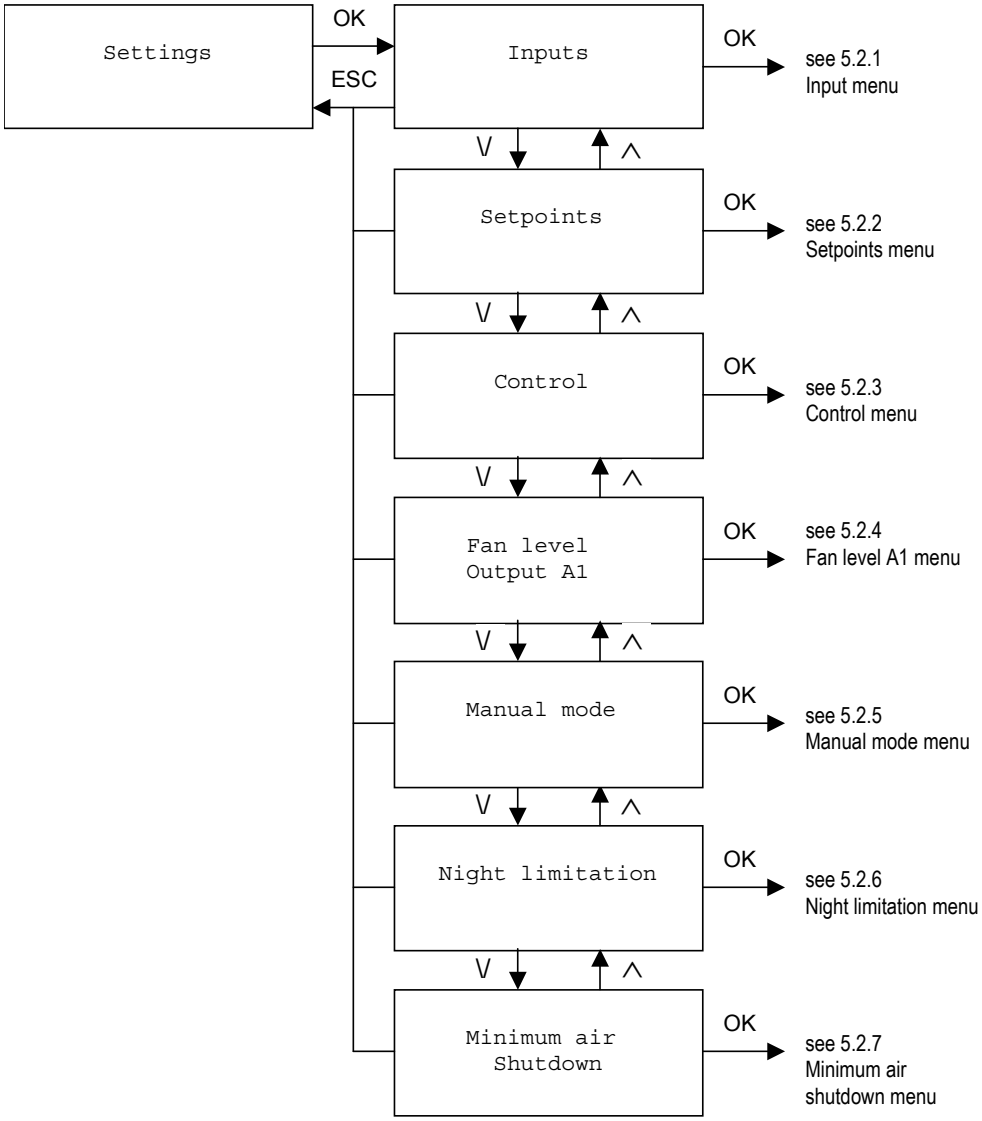
- Control over 0-10V output
- Control over Modbus output
- Plant monitoring over Modbus output

The following tables show how the device is configured for the preset operating modes:

Operating mode	Control over 0-10V output	Control over Modbus output	Plant monitoring over Modbus output
Modbus function	OFF	ON	ON
Init range	32	32	32
Rot direction source	OFF	OFF	OFF
Preferred direction	Clockwise	Clockwise	Clockwise
Setpoint director	Controller	Controller	Manual

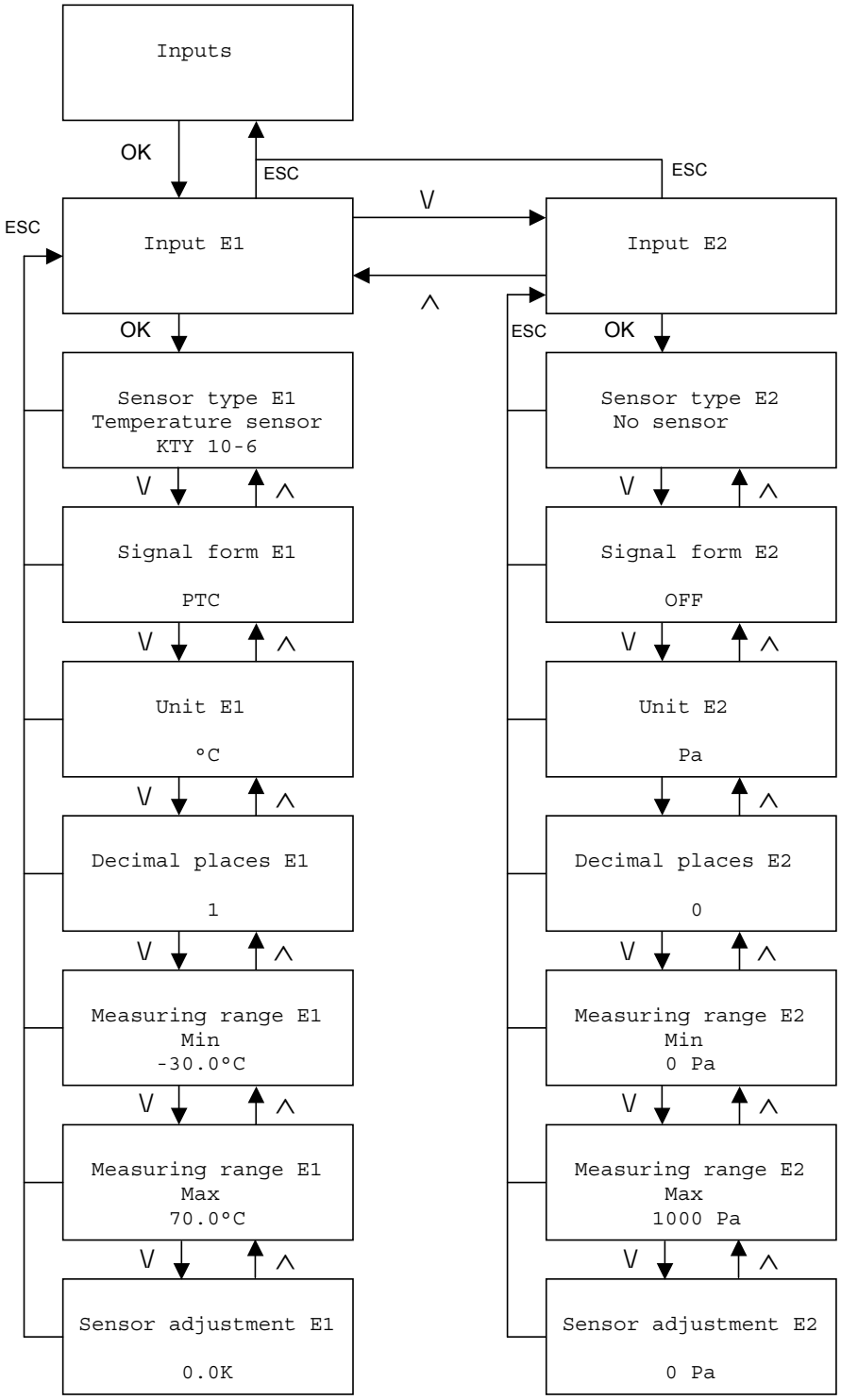
5.2 Settings menu

This menu item has various sub-menu items which are presented in this overview:



5.2.1 Inputs menu

Settings > Inputs



See 5.2.1.1

See 5.2.1.2

See 5.2.1.3

See 5.2.1.4

See 5.2.1.5

See 5.2.1.5

See 5.2.1.6

5.2.1.1 Sensor type

Settings > Inputs > Input E1 > Sensor type

```
Sensor type E1
Temperature sensor
KTY 10-6
```

Here, a sensor from the ebm-papst range can be selected.

Possible values:

- Individual
- Temperature sensor KTY 10-6 (R25 = 2kΩ)
- Temperature sensor NTC 103AT (R25 = 10kΩ)
- Temperature sensor 50003-1-0174 (output 0..10V)
- Temperature sensor 50005-1-0174 (output 0..10V)
- Pressure sensor 0...100Pa (output 0..10V)
- Pressure sensor 0...200Pa (output 0..10V)
- Pressure sensor 0...500Pa (output 0..10V)
- Pressure sensor 0..1000Pa (output 0..10V)
- Pressure sensor 0..30bar (output 4..20mA)
- No sensor

If a sensor proposed by ebm-papst is chosen (value ≠ "Individual"), the properties of the sensor (i.e. remaining values in the "Input E1" or "Input E2" menu) are **automatically** adapted to reflect the choice of sensor and overwritten with the preset values.

When a sensor proposed by ebm-papst is selected, the input option for the remaining values in the "Input E1" or "Input E2" menu is blocked (with the exception of the sensor comparison check).

The following values are assigned to the sensors proposed by ebm-papst:

Sensor type	Temperature sensor KTY 10-6	Temperature sensor NTC 103AT	Temperature sensor 50003-1-0174	Temperature sensor 50005-1-0174	Pressure sensor 0...100Pa
Signal form	PTC	NTC	0-10V	0-10V	0-10V
Unit	°C	°C	°C	°C	Pa
Decimal places E1	1	1	1	1	0
Measuring range E1 min	-30.0	-30.0	6.0	-20.0	0
Measuring range E1 max	70.0	90.0	45.0	80.0	100
Sensor comparison check	0.0	0.0	0.0	0.0	0

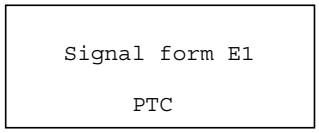
Sensor type	Pressure sensor 0...200Pa	Pressure sensor 0..500Pa	Pressure sensor 0..1000Pa	Pressure sensor 0...30 bar	No sensor
Signal form	0-10V	0-10V	0-10V	4-20mA	OFF
Unit	Pa	Pa	Pa	bar	Pa
Decimal places E1	0	0	0	2	0
Measuring range E1 min	0	0	0	0.00	0
Measuring range E1 max	200	500	1000	30.00	1000
Sensor comparison check	0	0	0	0.00	0

The selection option of "No sensor" is provided for open inputs, e.g. if only one sensor is used. In the display for the corresponding actual value in this instance, no value appears (---).
For processing purposes, the value 0 is assigned to the corresponding actual value.

Once a sensor is connected which is not available in the above list of preconfigurable sensors, you must choose the "Individual" selection option.
In this instance, all parameters in the "Input E"' or "Input E2" are adapted to suit the sensor in order to assure that each sensor parameter is displayed correctly.

5.2.1.2 Signal form

Settings > Inputs > Input E1 > Signal form



Here, the form of sensor output signal is entered.

Possible values:

- PTC
- NTC
- 0-10V
- 0-20mA
- 4-20mA
- OFF

The sensor *must* be connected to the intended input on the control device:

Setting	Input *)	Terminals *)	Min. value	Max. value
PTC	PTC temperature sensors	1+2	1240Ω	2790Ω
NTC	NTC temperature sensors	29+30	111kΩ	1266Ω
0-10V	0..10V	9+10	0V	10V
0-20mA	0/4..20mA	6+10	0 mA	20 mA
4-20mA	0/4..20mA	6+10	4 mA	20 mA
OFF	---	---	---	---

*) see 2.4

For calculation of the actual value, the signal from the input selected here is used.

If this input is at the same value as the Min. Value defined here,
the value set in the "Measuring range E1 Min" (see 5.2.1.5) is displayed. **)

If this input is at the same value as the Max. Value defined here,
the value set in the "Measuring range E1 Max" (see 5.2.1.5) is displayed. **)

Intermediate values are then calculated in linear fashion.

For the value "OFF", the actual value is always 0.

**) For the sensor comparison check Offset = 0 (see 5.2.1.6)

5.2.1.3 Unit

Settings > Inputs > Input E1 > Unit

```
Unit E1

°C
```

The unit set here is used for all displays which refer to the sensor connected to this input (e.g. actual value, setpoints,...)

The following units are possible:

- °C *) - temperature
- bar - pressure
- Pa - pressure
- m³ / h - air flow
- m / s - speed

*) When unit °C is selected, temperature differences are displayed with the unit "K".

5.2.1.4 Decimal places

Settings > Inputs > Input E1 > Decimal places

```
Decimal places E1

1
```

The "Decimal places" value defines the resolution and the value range for the display of all values referring to the sensor connected to this input (e.g. Actual value, setpoints...)

The following values are possible:

Decimal places	Resolution	Value range
0	1	-9999 ... 9999
1	0.1	-999.9 ... 999.9
2	0.01	-99.99 ... 99.99
3	0.001	-9.999 ... 9.999

Values outside the value range cannot be displayed and set!

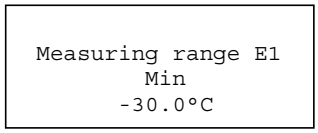
When the Decimal places are increased, it is possible that other values (e.g. Actual value, setpoints...) can no longer be displayed because they lie outside the value range!

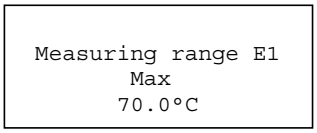
In this case, the display for these values is as follows:
- MAX for a value greater than the value range
- MIN for a value less than the value range

In this case, it is advisable to check all values in the "Settings" menu for compliance with the value range and, if necessary, to reconfigure them.

5.2.1.5 Measuring range

Settings > Inputs > Input E1 > Measuring range





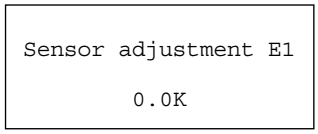
Here, you should enter the measuring range for the sensor:

Signal form	E1 Min	E1 Max
PTC	Sensor parameter at 1240Ω	Sensor parameter at 2790Ω
NTC	Sensor parameter at 111kΩ	Sensor parameter at 1266Ω
0-10V	Sensor parameter at 0V	Sensor parameter at 10V
0-20mA	Sensor parameter at 0mA	Sensor parameter at 20mA
4-20mA	Sensor parameter at 4mA	Sensor parameter at 20mA

These values directly influence the calculation of the actual value.

5.2.1.6 Sensor comparison check

Settings > Inputs > Input E1 > Sensor comparison check



Here the output value of the sensor can be changed subsequently to compensate for deviations in the output signal.
The value set here is added to the value established.

5.2.1.7 Calculation of the actual value

The parameters described in Chapter 5.2.1 Menu inputs determine how the actual value is calculated, depending on the signal form selected, as follows:

Signal form "PTC" : $Actual\ value = \frac{(R - 1260\Omega)}{1530\Omega} \cdot (Max - Min) + Min + Offset$

Signal form "0-10V" : $Actual\ value = \frac{U}{10V} \cdot (Max - Min) + Min + Offset$

Signal form "0-20mA" : $Actual\ value = \frac{I}{20mA} \cdot (Max - Min) + Min + Offset$

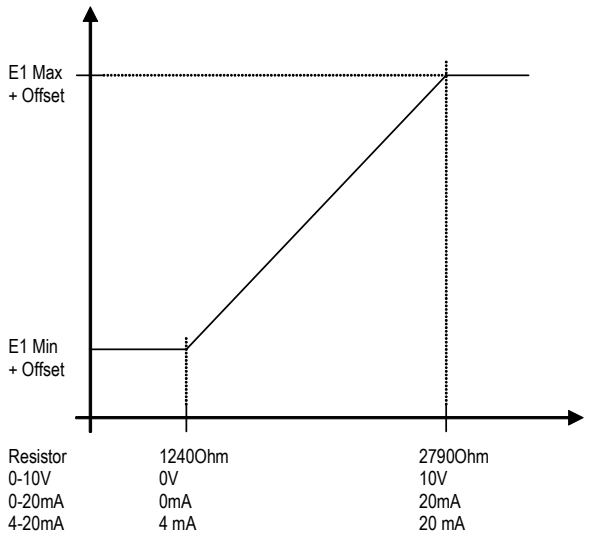
Signal form "4-20mA" : $Actual\ value = \frac{(I - 4mA)}{16mA} \cdot (Max - Min) + Min + Offset$

Signal form "OFF" : $Actual\ value = 0$

R ..... Resistor at input for "Temperature sensor"
U ..... Voltage at input "0..10V"
I ..... Current at input "0/4..20mA "
Max ..... Maximum sensor value (Setpoint)
Min ..... Minimum sensor value (Setpoint)
Offset ..... Sensor comparison check, offset (Setpoint)

If the applicable limit values for the signal form (1240..2790Ω; 0..10V; 0..20mA; 4..20mA) are exceeded, the corresponding limit value is assumed to apply for calculating the relevant limit value.

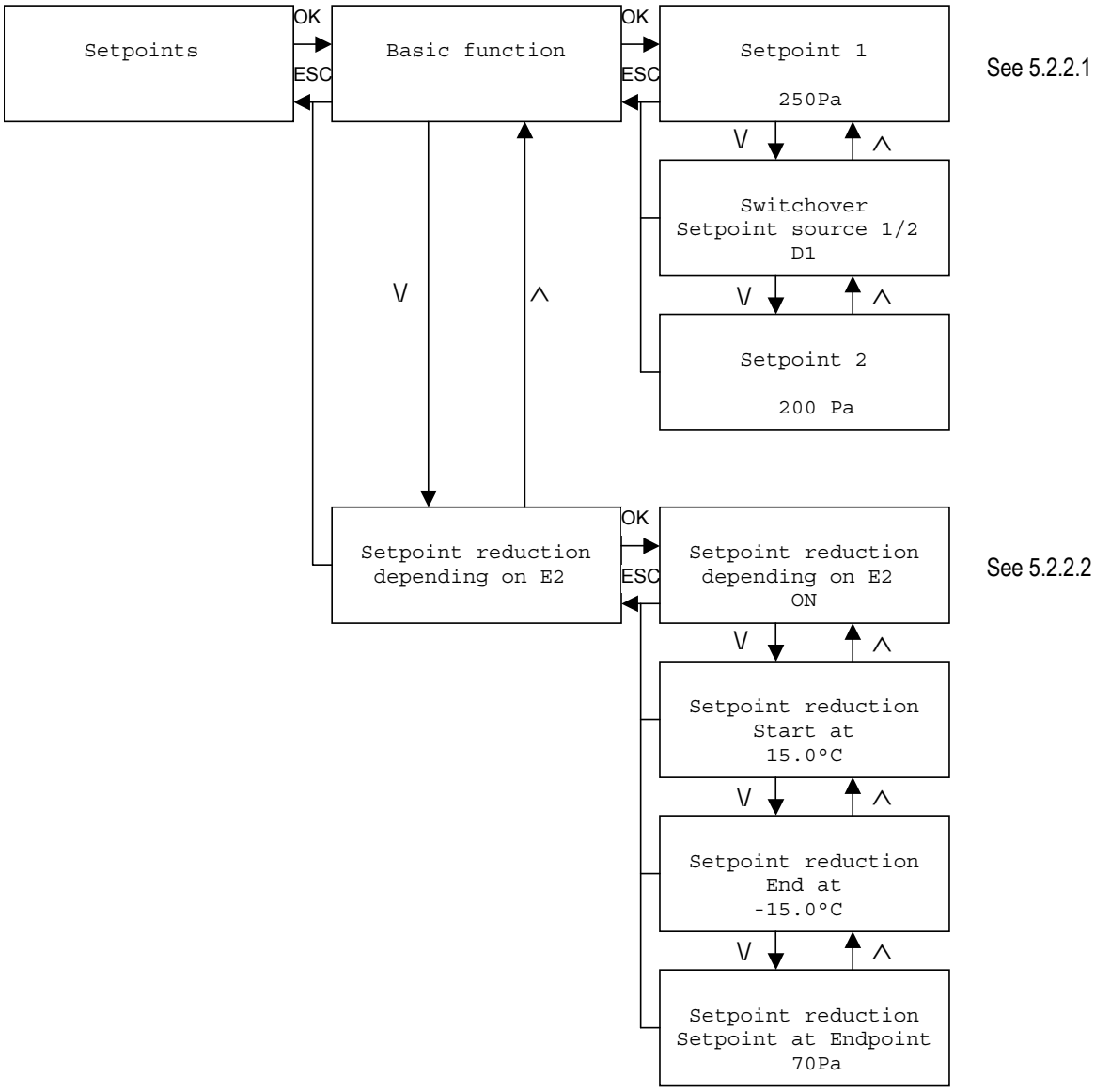
This yields the following characteristic curve for the actual value:



For signal form "NTC", the actual value is calculated via a nonlinear table.
For the curve, refer to the data sheet of the NTC 103AT.

5.2.2 Setpoints menu

Settings > Setpoints



5.2.2.1 Basic functions

Settings > Setpoints > Basic function

Via the menu items "Setpoint 1" and "Setpoint 2", two different setpoints can be set for the control parameter.

With "switchover setpoint source 1/2", a digital input can be selected which determines whether setpoint 1 or setpoint 2 should be used.

If the value "OFF" is selected for "Switchover setpoint source 1/2", the system always uses setpoint 1; for setpoint 2, no value appears (---) and there is also no input option.

Possible settings for "Switchover, setpoint source 1/2"

• OFF	: always:	Setpoint 1
• D1	: Digital input 1 = open:	Setpoint 1
	Digital input 1 = GND:	Setpoint 2
• D2	: Digital input 2 = open:	Setpoint 1
	Digital input 2 = GND:	Setpoint 2
• D3	: Digital input 3 = open:	Setpoint 1
	Digital input 3 = GND:	Setpoint 2
• D4	: Digital input 4 = open:	Setpoint 1
	Digital input 4 = GND:	Setpoint 2

5.2.2.2 Setpoint reduction depending on E2

» Settings > Setpoints > Setpoint reduction depending on E2

a) Activation

```
Setpoint reduction
depending on E2
      ON
```

With this parameter, the function "Setpoint reduction depending on E2" can be enabled and disabled.

Possible values:

OFF	: Function disabled; setpoint corresponds to the setpoint of the basic function*).
ON	: Function enabled: setpoint of basic function*) is altered dependent upon actual value E2.

*) Setpoint of the basic function is either setpoint 1 or setpoint 2 (see 5.2.2.1)

b) Function

```
Setpoint reduction
    Start at
     15.0°C
```

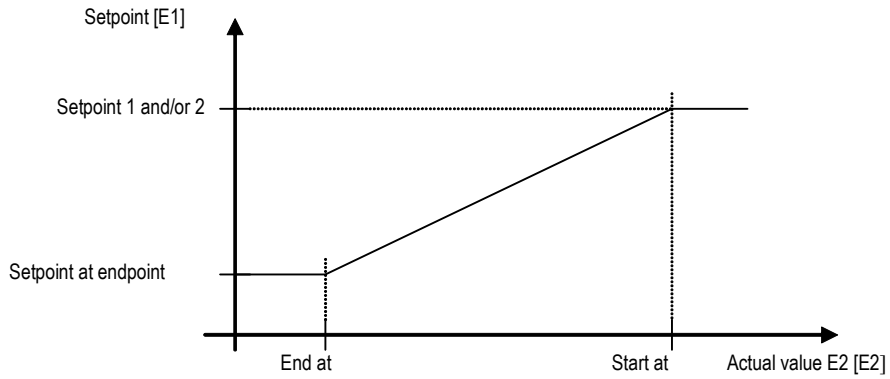
```
Setpoint reduction
    End at
   -15.0°C
```

```
Setpoint reduction
Setpoint at Endpoint
      70Pa
```

For the function "Setpoint reduction depending on E2", 3 parameters need to be set:

- Setpoint reduction Start at
- Setpoint reduction End at
- Setpoint at endpoint

With these parameters, a curve is defined which shows how the setpoint of the basic function changes in relation to the actual value on input E2:



For actual value E2 ≥ "Start at" is:	Setpoint = Setpoint of basic function.
For "End at" ≤ Actual value E2 < "Start at" becomes:	Setpoint of basic function changed in linear fashion.
For actual value E2 < "End at" is:	Setpoint = Setpoint at endpoint

Limitations:

- The parameter "Start at" must always be greater than or equal to the parameter "End at". Parameters outside these limits cannot be set and are restricted automatically.
- The setpoint at endpoint must not be greater than the setpoint of the basic function.
  In this case, the setpoint for actual value E2 < "Start at" is increased instead of reduced.
- If the function "Setpoint reduction depending on E2" is disabled, no value (---) appears beside any of the values. There is then no input option.

The "Setpoint reduction" function should be enabled only if sensor E2 is active! (Signal form E2 ≠ "OFF")

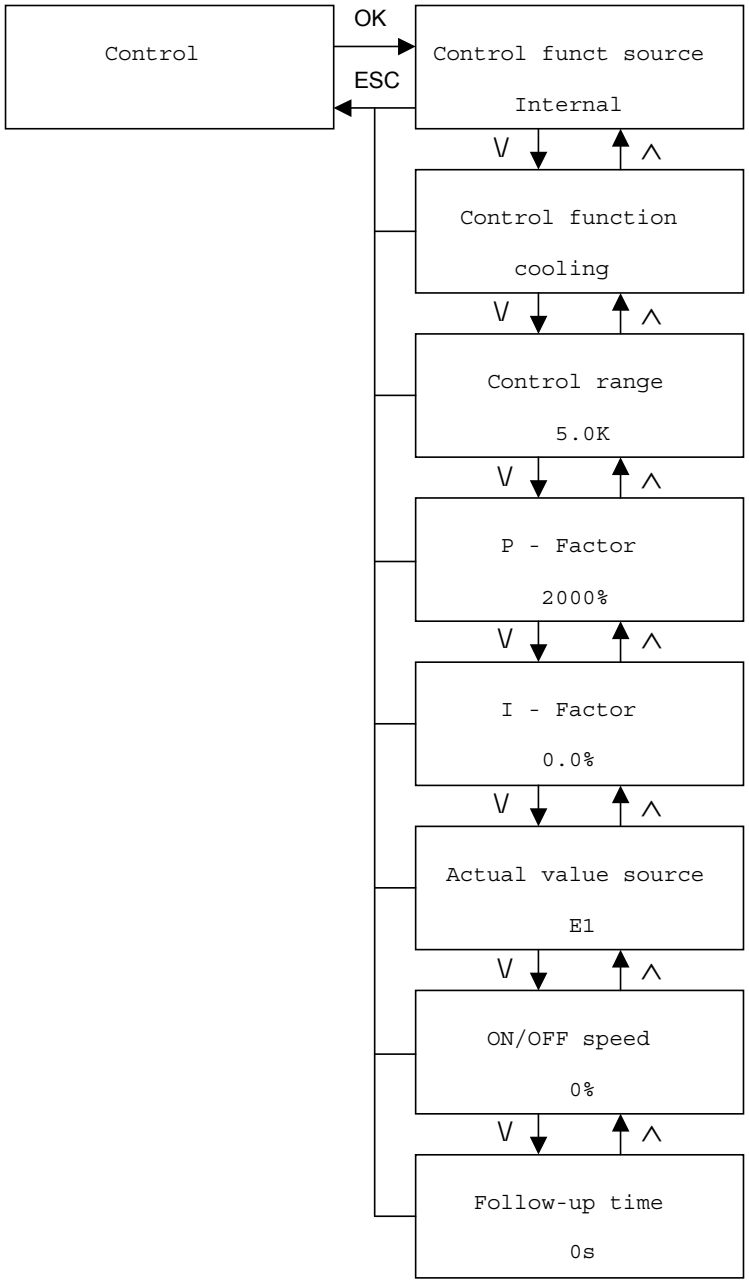
Otherwise, the value 0 is used as the actual value E2.

Application:

This function is preferably used for pressure control or air flow control with ambient temperature compensation.
At input E1, a pressure or air flow rate sensor is then required.
At input E2, a temperature sensor is connected.
The pressure or air flow rate setpoint is reduced in linear fashion as a function of the measured (ambient) temperature as soon as ambient temperature drops below the "Start at" level.
Below an ambient temperature of "End at", the setpoint = "Setpoint at endpoint".

5.2.3 Control menu

Settings > Control



See 5.2.3.1

See 5.2.3.1

See 5.2.3.2

See 5.2.3.2

See 5.2.3.3

See 5.2.3.5

See 5.2.3.6

See 5.2.3.6

5.2.3.1 Control function

Settings > Control > Control function

a) Control funct source

```
Control funct source

      Internal
```

Using the parameter "Control funct source", you select which source the control function is established from.
With "Internal", the value set for the "Control function" parameter is adopted.
If a digital input is selected, the status of that digital input determines the control function.

Possible values:

• Internal	:	Control function = "Control function" parameter
• D1	: Digital input 1 = open:	Control function = Heating*)
	Digital input 1 = GND:	Control function = Cooling**)
• D2	: Digital input 2 = open:	Control function = Heating*)
	Digital input 2 = GND:	Control function = Cooling**)
• D3	: Digital input 3 = open:	Control function = Heating*)
	Digital input 3 = GND:	Control function = Cooling**)
• D4	: Digital input 4 = open:	Control function = Heating*)
	Digital input 4 = GND:	Control function = Cooling**)

b) Control function (internal)

```
Control function

    cooling
```

Here the operating direction of the controller can be set provided that the "Control funct source" parameter is set to "Internal".

Possible values:

- Heating*)
- Cooling**)

*) Heating: Control function positive i.e. control deviation = setpoint - actual value
**) Cooling: Control function negative i.e. control deviation = actual value - setpoint

5.2.3.2 Control range and P - Factor

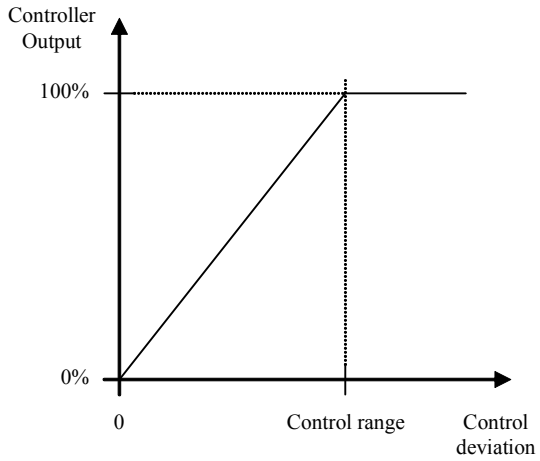
Settings > Control > Control range / P - Factor

Control range	P - Factor
5.0K	2000%

Control range and P - Factor are different ways of depicting the same value.
Both values determine the P share (share of absolute deviation) of the PI controller.
If one of these values changes, the other value also changes automatically.

Control range:

The presentation via this control range is intended for use as a P-controller, i.e. the I - Factor is set to 0%.
The control range then indicates the control deviation figure for which the controller output changes from 0 to 100%.
This relationship is depicted by the following diagram:



P - Factor:

If an I - Factor is set > 0%, the control range cannot be depicted meaningfully in a diagram. For this case, the screen display of P - Factor is provided.

The P - Factor is standardised to the measuring range of the sensor [E1 Min - E1 Max] or [E2 Min - E2 Max]. The "Actual value source" parameter decides which of these two sensors (E1 or E2) is used for this purpose.

With a P - Factor of 100% and a control deviations of (Max - Min), the resultant P share is a value of 100%.
General:

$$P\ share = P\ Factor \cdot \frac{Control\ deviation}{Max - Min}$$

Max ..... Sensor measuring range maximum value (E1 Max or E2 Max)
Min ..... Sensor measuring range minimum value (E1 Min or E2 Min)

The display as P - Factor and as Control range can be converted in either direction using the following equations:

$$P\ Factor = \frac{100}{Control\ deviation} \cdot (Max - Min)$$

$$Control\ deviation = \frac{100}{P\ Factor} \cdot (Max - Min)$$

Following a change in measuring range (Max, Min), the
control range remains unchanged. The P - Factor changes accordingly.

5.2.3.3 I - Factor

≫ Settings > Control > I - Factor

```
I - Factor

0.0%
```

The I - Factor determines the integral share (share of totals of all deviations) for the PI controller.

The I - Factor is standardised on the measuring range of the selected sensor [E1 Min - E1 Max] or
[E2 Min - E2 Max]) and the P - Factor. The "Actual value source" parameter decides which of these two sensors (E1 or E2) is used for this purpose.
With an I - Factor and a P - Factor of 100% and a control deviation of (Max - Min), a value of 100% is obtained for changes to the I-share.
General:

$$\Delta I\ share = I\ Factor \cdot \frac{P\ Factor}{100\%} \cdot \frac{Control\ deviation}{Max - Min}$$

For the I - Factor = 0%, the I-share is always = 0.
This then involves a proportional controller ("P-controller")

5.2.3.4 Control behaviour

The following equations enable the control behaviour of the control device to be demonstrated.

The controller output comprises a P-share and an I-share:

$$Controller\ output = P\ share + I\ share$$

The controller output always has a value range of 0 to 100%.
The controller output must not be confused with the duty cycle (see 5.2.4.1.)
The controller output at time T = n * Ta is then

$$Controller\ output(n) = P\ share(n) + \sum_{i=0}^{n} \Delta I\ share(i)$$

With equations for the P-share and the difference of the I-share (see above), this results in:

$$Controller\ output(n) = \frac{P\ Factor}{Max - Min} \cdot xd(n) + \sum_{i=0}^{n} I\ Factor \cdot \frac{P\ Factor}{100\%} \cdot \frac{xd(i)}{Max - Min}$$

Controller output	Controller output
Tn	Control deviation
P Factor	P - Factor set on control device (see above)
I Factor	I - Factor set on control device (see above)
Max	Sensor measuring range maximum value (E1 Max or E2 Max)
Min	Sensor measuring range minimum value (E1 Min or E2 Min)

This equation is carried out in real time by the control device.

Through a process of reshaping, this can be transferred to the standard form of presentation for control functions:

$$Controller\ output(n) = \frac{P\ Factor}{Max - Min} \cdot xd(n) + \frac{P\ Factor}{Max - Min} \cdot \frac{I\ Factor}{100\%} \cdot \sum_{i=0}^{n} xd(i)$$

$$Controller\ output(n) = \frac{P\ Factor}{Max - Min} \cdot \left(xd(n) + \frac{I\ Factor}{100\%} \cdot \sum_{i=0}^{n} xd(i) \right)$$

with:

$$Kp = \frac{P\ Factor}{Max - Min}$$

and

$$\frac{Ta}{Tn} = \frac{I\ Factor}{100\%}$$

the standard form of presentation for a PI controller is created:

$$Controller\ output(n) = kp \cdot \left(xd(n) + \frac{Ta}{Tn} \cdot \sum_{i=0}^{n} xd(i) \right)$$

kp	Proportional amplification factor
Tn	Readjustment time
Ta	Sensing time

When required, the control device parameters can be converted using the following equations into the standard form of presentation (and vice versa):

$$Kp = \frac{P\ Factor}{Max - Min} \quad \text{or} \quad P\ Factor = Kp \cdot (Max - Min)$$

$$Tn = \frac{100\%}{I\ Factor} \cdot 50ms \quad \text{or} \quad I\ Factor = \frac{50ms}{Tn} \cdot 100\%$$

5.2.3.5 Actual value source

Settings > Control > Actual value source

```
Actual value source
        E1
```

The parameter "Actual value source" can be used to select which input should supply the actual value for the controller.

Possible values:

- E1 : Actual value from Input E1 is used
- E2 : Actual value from Input E2 is used
- Max(E1;E2) : The higher actual value for both inputs E1 and E2 is used.

Applications:

For the basic function, it is advisable to use input E1 as the 'Actual value source'.
If input E2 is used, other functions defined on input E2 cannot be used (e.g. setpoint reduction depending on E2).

The Max(E1;E2) setting is used for:

- Two circuit condensers: control to higher pressure
- Temperature control with 2 sensors: control to higher temperature

Selecting "Max(E1;E2)" is logical only if:

- Both sensors are active (Signal form E1 ≠ "OFF" AND Signal form E2 ≠ "OFF")
- Both sensors have the same unit (Unit E1 = Unit E2)

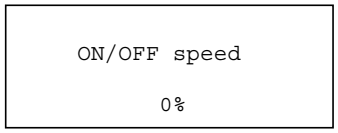
Otherwise, selecting "Max (E1; E2)" can cause undesirable effects:

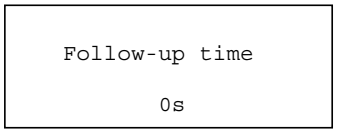
- If only one active sensor was selected, the actual value 0 is assumed for the inactive sensor!
- If the units of the two sensors are different, the unit of sensor E1 is always used for the actual value!

If the parameter "Actual value source" is changed, the P - Factor changes if a different measuring range has been selected for the sensors (Max, Min).
If necessary, the P - Factor must be corrected subsequently!

5.2.3.6 On/Off speed and follow-up time

Settings > Control > On/Off speed / Follow-up time





If the duty cycle reaches the value "On/Off speed", the time set in "Follow-up time " remains at the value of the "On/Off speed".
If the duty cycle does not rise again on completion of the follow-up time, i.e. if it still has a value of "On/Off speed"), the duty cycle is set to a minimum level from this time onwards of "Min. speed".
The duty cycle remains at this value until the control deviation becomes positive again.

The maximum value for the follow-up time is 254s. If the value is increased even more using the ▲ button, ---s appears in the display. This means the value "infinite", i.e. the duty cycle never falls below the value for "On/Off speed".

Application:

The 0..10V input for ebm-papst fans is defined in such a way that the fan stops whenever the allowed value drops below 1V or comes to rest at that level.

Through favourable setting of these parameters it is possible to prevent the output signal from the control device dropping below 10% and the fan therefore shutting down briefly in response to a negative setpoint jump (specifying a lower setpoint) and an I-share > 0, until such time as the actual value drops back below that of the setpoint. (in unfavourable cases, this shutdown can cause the controller to vibrate).

With PI controllers (I-share > 0), it is therefore necessary to note the following points:

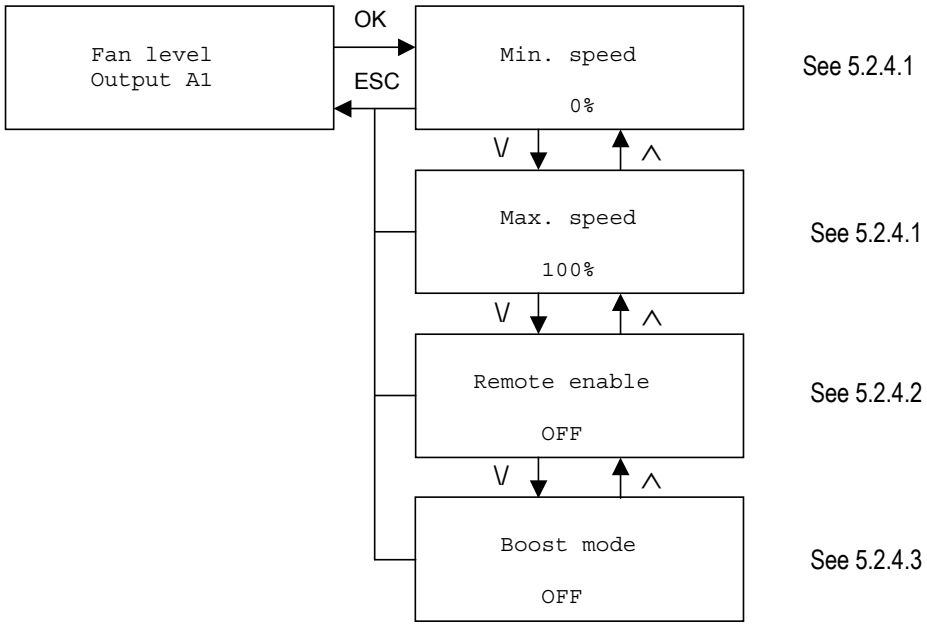
The On/Off speed should be set to a value substantially above that of the engagement threshold of the fan (e.g. with the ebm-papst catalogue fan 12%).
The value for the follow-up time is dependent on the control system. The maximum time period needs to be established during which the controller output remains at the value "On/Off speed" in response to negative setpoint jumps. The follow-up time must be greater than this period of time.

Comment:

If the fan shuts down briefly in response to negative setpoint jumps, you must
1. Set the "On/Off speed" to a value greater than the engagement threshold
2. Increase the "Follow-up time" until the fan ceases to shut down.

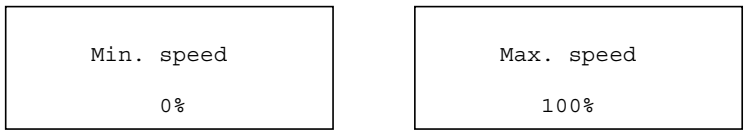
5.2.4 Menu for Fan level A1

Settings > Fan level A1



5.2.4.1 Min. speed and max. speed

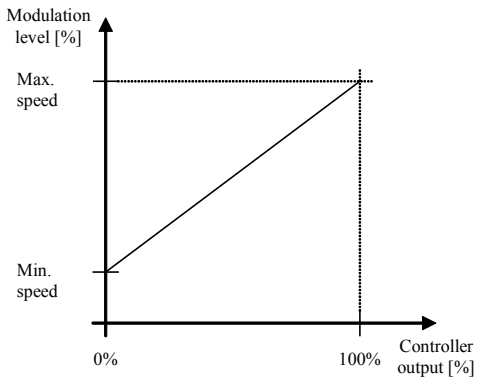
Settings > Fan level A1 > Min. speed / Max. speed



The two parameters "Min. speed" and "Max. speed" determine the function which assigns a duty cycle to the controller output.
With a controller output of 0%, the duty cycle quoted at output A1 for "Min. speed" is issued.
With a controller output of 100%, the duty cycle quoted at output A1 for "Max. speed" is issued.
Between these points, the response characteristics are linear, i.e the value range for the duty cycle [Min. speed .... Max. speed] are assigned to the value range of the controller output [0 to 100%].

A duty cycle of 0% corresponds to a voltage of 0V at output A1.
A duty cycle of 100% corresponds to a voltage of 10V at output A1.

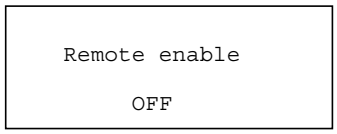
This relationship is depicted by the following graphic:



With these parameters, it is possible to set a restriction on the duty cycle (minimum or maximum level).

5.2.4.2 Remote enable

Settings > Fan level A1 > Remote enable



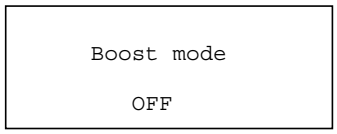
With this parameter, a digital input can be selected which releases and/or blocks output A1 on the control device.
If output A1 was blocked, a voltage of 0V is then issued permanently at this output.

Possible values:

• OFF	: always:	Output A1 released
• D1	: Digital input 1 = open:	output A1 blocked (=0V)
	Digital input 1 = GND:	output A1 released
• D2	: Digital input 2 = open:	output A1 blocked (=0V)
	Digital input 2 = GND:	output A1 released
• D3	: Digital input 3 = open:	output A1 blocked (=0V)
	Digital input 3 = GND:	output A1 released
• D4	: Digital input 4 = open:	output A1 blocked (=0V)
	Digital input 4 = GND:	output A1 released

5.2.4.3 Boost mode

Settings > Fan level A1 > Boost mode



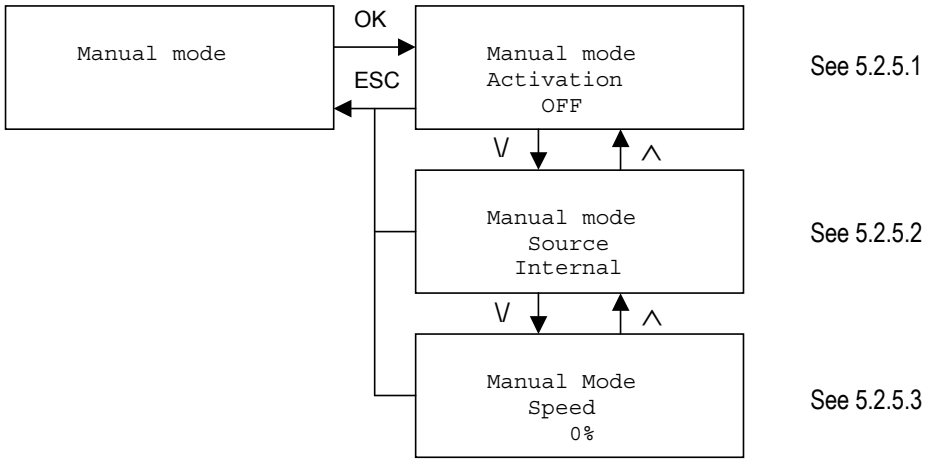
With this parameter, a digital input can be selected which sets output A1 on the control device to boost mode (10V), provided that this input is connected to ground.
("Boost Function")

Possible values:

• OFF	: always:	Function "Boost mode" disabled
• D1	: Digital input 1 = open:	Function "Boost mode" disabled
	Digital input 1 = GND:	Function "Boost mode" enabled
• D2	: Digital input 2 = open:	Function "Boost mode" disabled
	Digital input 2 = GND:	Function "Boost mode" enabled
• D3	: Digital input 3 = open:	Function "Boost mode" disabled
	Digital input 3 = GND:	Function "Boost mode" enabled
• D4	: Digital input 4 = open:	Function "Boost mode" disabled
	Digital input 4 = GND:	Function "Boost mode" enabled

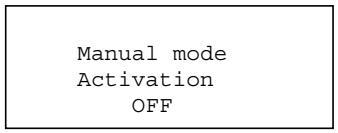
5.2.5 Manual mode

Settings > Manual mode



5.2.5.1 Manual mode activation

Settings > Manual mode > Manual mode activation



The parameter "Manual mode activation" switches the "Manual mode" function on and off.

Possible values:

• OFF	: Control to preset setpoint	
• ON	: Manual speed setting	
• D1	: Digital input D1 = open	: Control to configured setpoint
	Digital input D1 = GND	: Manual speed setting
• D2	: Digital input D2 = open	: Control to configured setpoint
	Digital input D2 = GND	: Manual speed setting
• D3	: Digital input D3 = open	: Control to configured setpoint
	Digital input D3 = GND	: Manual speed setting
• D4	: Digital input D4 = open	: Control to configured setpoint
	Digital input D4 = GND	: Manual speed setting

If the "Manual mode" function is disabled (OFF), the signal at output A1 is always modulated to the configured setpoint. When manual mode is enabled (ON), the signal selected via manual mode source is output (see 5.2.5.2). In addition, by selecting a digital input, you have the option to activate manual mode using an external switch.

5.2.5.2 Manual mode source

Settings > Manual mode > Manual mode source

```
Manual mode
  source
Internal
```

Possible values:

- Internal : Duty cycle is determined by the "Manual mode speed" parameter
- E1 0-10V : Duty cycle is determined by the signal at 0..10V input 1
- E2 0-10V : Duty cycle is determined by the signal at 0..10V input 2
- E1 0-20mA : Duty cycle is determined by signal at 0..20mA input 1
- E2 0-20mA : Duty cycle is determined by signal at 0 ..20mA input 2
- E1 4-20mA : Duty cycle is determined by signal at 4..20mA input 1
- E2 4-20mA : Duty cycle is determined by signal at 4..20mA input 2

This parameter is effective only if the "Manual mode" function is activated (see 5.2.5.1)

For "Manual mode source" = "Internal", the value that appears in the "Manual mode speed" parameter is output (see 5.2.5.3). For all other values, the duty cycle is calculated from the signal of the selected input and the parameters "Minimum speed" and "Maximum speed" (see 5.2.4.1).

The control range of the specific input is mapped in linear form to the range defined by the parameters "Minimum speed" and "Maximum speed":

E1 0-10V $$Duty\ cycle = \frac{U(E1)}{10V} \cdot (nMax - nMin) + nMin$$

E2 0-10V $$Duty\ cycle = \frac{U(E2)}{10V} \cdot (nMax - nMin) + nMin$$

E1 0-20mA $$Duty\ cycle = \frac{I(E1)}{20mA} \cdot (nMax - nMin) + nMin$$

E2 0-20mA $$Duty\ cycle = \frac{I(E2)}{20mA} \cdot (nMax - nMin) + nMin$$

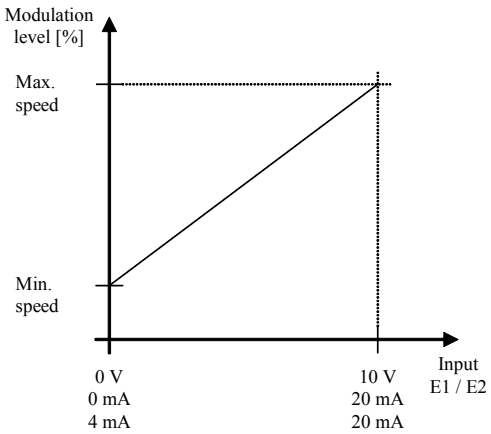
E1 4-20mA $$Duty\ cycle = \frac{I(E1) - 4mA}{16mA} \cdot (nMax - nMin) + nMin$$

E1 4-20mA $$Duty\ cycle = \frac{I(E2) - 4mA}{16mA} \cdot (nMax - nMin) + nMin$$

nMin ..... Minimum speed
U(E1) ..... Voltage at 0-10V input 1
I(E1) ..... Current at 0/4-20mA input 1

nMax ..... Maximum speed
U(E2) ..... Voltage at 0-10V input 2
I(E2) ..... Current at 0/4-20mA input 2

The following illustration shows the relationships in graphic form:



5.2.5.3 Manual mode speed

Settings > Manual mode > Manual mode speed

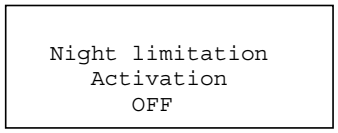
```
Manual mode
   speed
     0%
```

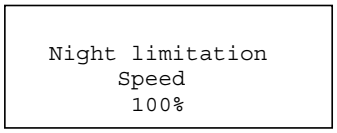
This parameter defines the duty cycle that is output when manual mode is switched on (see 5.2.5.1) and "Manual mode source" = internal (see 5.2.5.2).

A duty cycle of 0% corresponds to a voltage of 0V at output A1.
A duty cycle of 100% corresponds to a voltage of 10V at output A1.

5.2.6 Night reduction mode

» Settings > Fan level A1 > Night limitation





With this parameter it is possible to place an upper limit on the duty cycle at output A1 (and therefore the speed of the fan).

This limitation can be enabled by means of the selected digital input.
If the function is enabled, output A1 restricts the duty cycle (i.e. "speed") to the value shown in the "Night limitation" parameter.

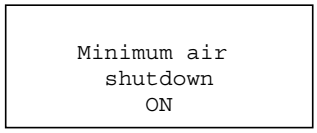
Possible values for "Night limitation activation":

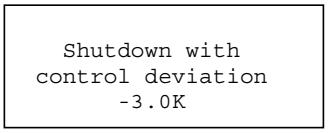
• OFF	: always:	No limitation
• D1	: Digital input 1 = open:	No restriction
	Digital input 1 = GND:	Restriction to "Night limitation speed"
• D2	: Digital input 2 = open:	No restriction
	Digital input 2 = GND:	Restriction to "Night limitation speed"
• D3	: Digital input 3 = open:	No restriction
	Digital input 3 = GND:	Restriction to "Night limitation speed"
• D4	: Digital input 4 = open:	No restriction
	Digital input 4 = GND:	Restriction to "Night limitation speed"

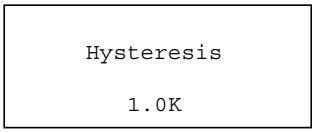
Application:
This function is used for the night reduction mode:
At the digital input selected in the "Night limitation" parameter, contact is made with a timeswitch. If this contact is closed during the night by this timeswitch, the speed is limited to the value set in the "Night limitation speed" parameter.

5.2.7 Minimum air shutdown

» Settings > Fan level A1 > Minimum air shutdown







The "Minimum air shutdown" function is used primarily when using the device as a pure P-controller.

Activation:

This function is enabled by the "Minimum air shutdown" parameter.

Possible values:

• OFF	: Function disabled
• ON	: Function enabled

Function:

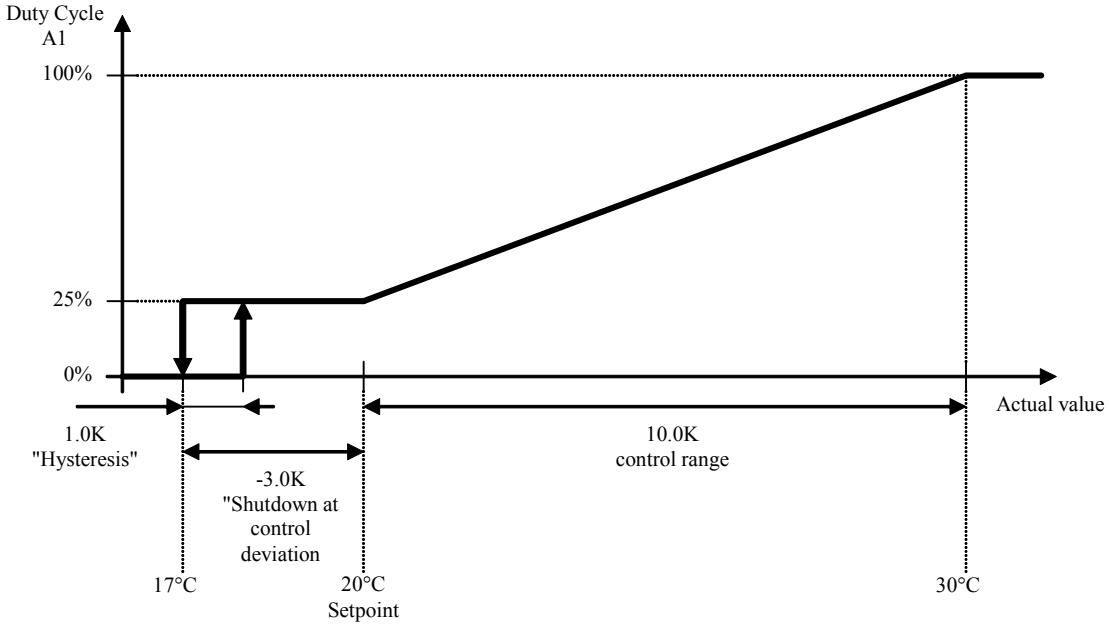
If the control deviation drops below the value set in the "Shutdown with control deviation" parameter, a voltage of 0V is issued at output A1. This shuts down the connected fan. The fan is not switched back on again until the control deviation exceeds the value for "Shutdown with control deviation" + "Hysteresis".

Example:

This function should be made clearer in the following example:

The relevant parameters have the following values:

Minimum air shutdown	: ON
Shutdown with control deviation	: -3.0K
Hysteresis	: 1.0K
Setpoint 1	: 20.0°C
Control range	: 10K
Control function	: Cooling
Min. speed	: 25%
Max. speed	: 100%



The duty cycle is changed in linear fashion for an actual value in the range [Setpoint .... Setpoint + Control range] = [20°C...30°C] across the range [Min. speed... Max. speed] = [25%...100%].

For the actual value < setpoint, the duty cycle corresponds to the min. speed value = 25%

If the control deviation drops below -3K, the duty cycle is set to 0%.
This is achieved at an actual value of 17°C:

$$Control\ deviation = Actual\ value - Setpoint = 17°C - 20°C = -3K \qquad (Cooling!)$$

The fan is switched back on (duty cycle = 25%) whenever the control deviation reaches this value

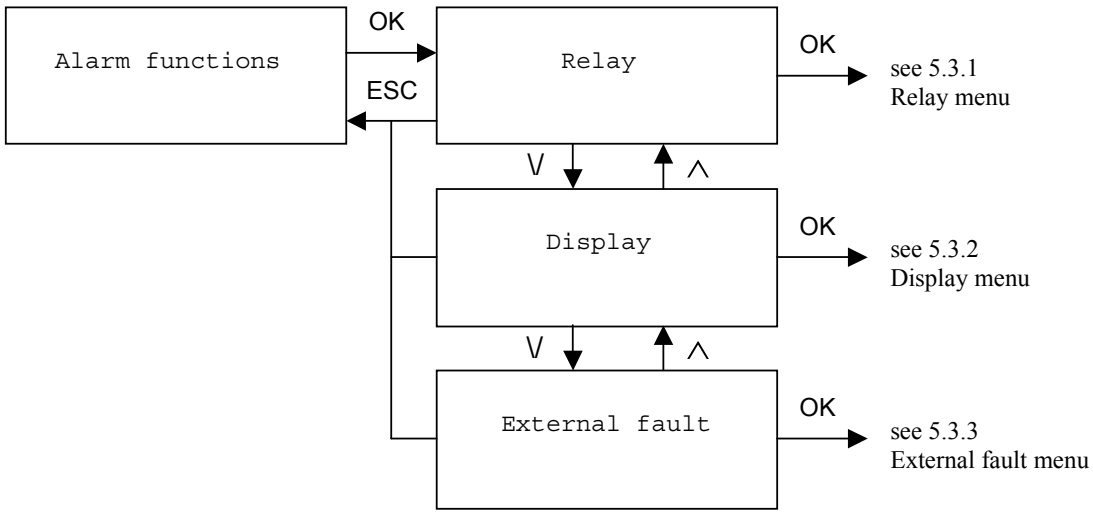
$$Control\ deviation = Shutdown\ with\ control\ deviation + Hysteresis = -3K + 1K = -2K.$$

This is the case with an actual value of 18°C.

Special features (presupposing a pure P-controller):

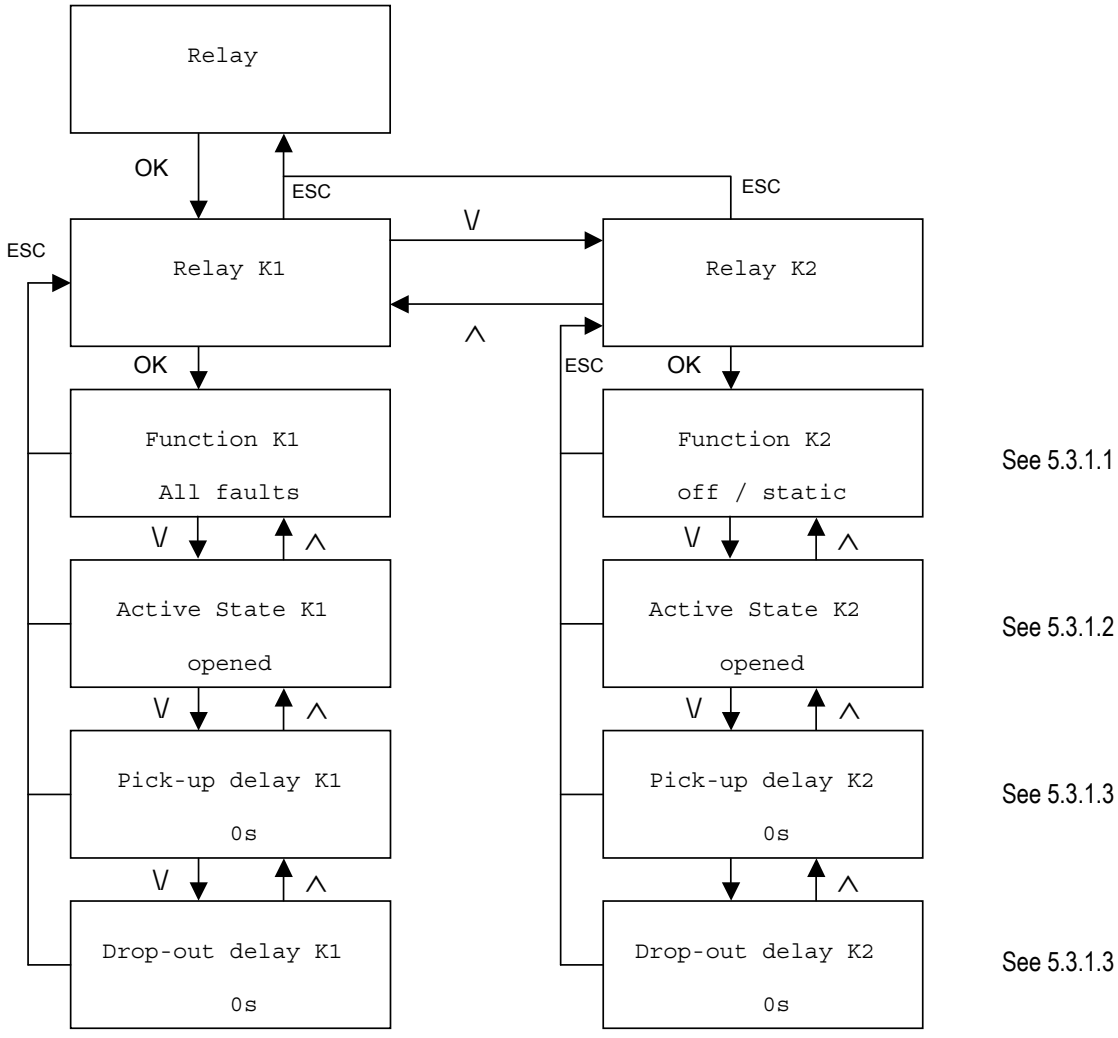
- If the "Shutdown with control deviation" parameter is positive, the system shuts down before the setpoint is reached (i.e. still within the control range).
  If the "Shutdown with control deviation" parameter is negative, the system does not shut down until the setpoint is reached.
- Hysteresis is only able to accept positive values. At a value of 0, the disengagement and engagement points are at one and the same level.
- If the "Min. speed" parameter = 0, the system always shuts down whenever the control deviation is negative, regardless of the parameters for minimum air shutdown.
  A negative switching point for the minimum air shutdown then has no effect.
- If the function is disabled ("minimum air shutdown" = "OFF", the motor always continues running with a negative control deviation at "Min. speed". The system only shuts down for "Min. speed" = 0.

5.3 Alarm functions menu



5.3.1 Relay menu

>>> Alarm functions > Relays



The menu items for relays K1 and K2 are identical in terms of layout. Here, by way of example, is a description of the menu items from relay K1. For the menu items of relay K2, the following applies.

5.3.1.1 Functions

Alarm functions > Relays> Relay K > Function

```
Function K1

All faults
```

Various functions can be assigned to these relays.
Every function has an enabled or 'active' status and a disabled or 'inactive' status.
A switching status for the relay contact is assigned to each of these statuses in the "Active state" menu item (see 5.3.1.2).

The following table shows the conditions for inactive and active state for each of the functions that can be set:

Function	Condition for disabled status	Condition for enabled status
Off / static	always satisfied	never satisfied
Sensor fault	both sensors (on E1 and E2) OK	Sensor fault on E1 or E2 (see 4.3.1)
External fault	No fault on the external device	Fault of the external device signalled via digital input (see 4.3.2)
Fan fault	All fans connected via Modbus are OK	Fault at fans connected via Modbus (see 4.3.3)
All faults	both sensors (on E1 and E2) OK and no faults on the external device and no fan fault	Sensor fault on E1 or E2 or fault of the external device signalled via digital input or fault at fans connected via Modbus
2nd group	Controller output < 95%	Controller output = 100%

Applications and explanations about the functions:

a) Off / static
This function is used:

- for indicating in operation mode that the control device is switched on
  In this case, the active status of the relay must be set to "opened" (see 5.3.1.2). The relay contact (NO switch) is then closed when the device is switched on
- For relays which are not required
  In this case, the active state of the relay must be set to "closed" (see 5.3.1.2). The relay contact (NO switch) always remains open.

b) Sensor fault / External fault / Fan fault / All faults
This function is used to signal the corresponding fault via the relay contact.

c) 2nd group
Using the relay contact, other fans can be engaged.
The relay contact switches the 2 groups on whenever the controller output reaches a value of 100%, i.e. if maximum fan power is not sufficient to reach the setpoint.
Once the controller output drops back below 95%, the 2nd group is switched off again.
The switching operations can be delayed using the "On-delay" and "Drop-out delay" parameters (see 5.3.1.3).

5.3.1.2 Relay statuses

Alarm functions > Relays > Relay K > Active Status

```
Active state K1

     opened
```

Using this parameter, a status for the relay contact can be assigned to the "Active state" of the relay (see 5.3.1.1):

Possible values:

opened	: in active state, the relay contact is opened
closed	: in active status, the relay contact is closed

The other status for the relay contact is therefore assigned to the inactive state.

Application:

For each function, you can configure whether the relay contact should be open or closed.

5.3.1.3 Switching delay

Alarm functions > Relay > Relay K > On-delay / Drop-out delay

```
On-delay K1

          0s
```

```
Drop-out delay K1

          0s
```

Using the "On-delay" and "Drop-out delay" parameters, a delay can be set for switching the relay contact.
This time starts to run as soon as the condition selected in 5.3.1.1 Functions is satisfied. The contact is switched as soon as the delay (i.e. time lag) has elapsed.

The "On-delay" parameter is applicable here for closing the relay contact;
The "Drop-out delay" is applicable here for opening the relay contact.

5.3.2 Sensor fault menu

Alarm functions > Screen display > Sensor fault

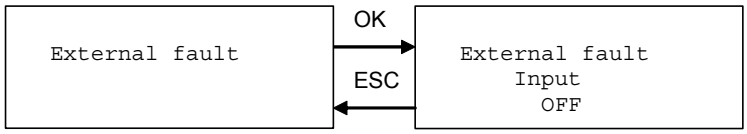
```
Screen display
  Sensor fault
      OFF
```

Here you can select whether a Sensor fault should be output on the display while the standard display is still enabled:

- Off: fault is not issued to the display during a standard display
- On: If a fault occurs on the sensor, it appears alternately on screen beside the standard display.

5.3.3 External fault input menu

Alarm functions > External fault > Input



Here, you can select a digital input at which the fault output of an external device is connected.

If no external device is connected to the control device, select the "OFF" setting here. In this case, the value "OK" is always displayed on the Alarm indication > Motor menu.

If a digital input was selected, an error is signalled in the Alarm indication > Motor menu whenever the fault output of the external device connected to it connected to it is opened (= high-impedance). In this case, the digital input on the control device is open.

The error is displayed simultaneously and alternately together with the standard display.
This display cannot be switched off using an additional menu item. If no error is displayed, the function needs to be disabled using the "OFF" setting.

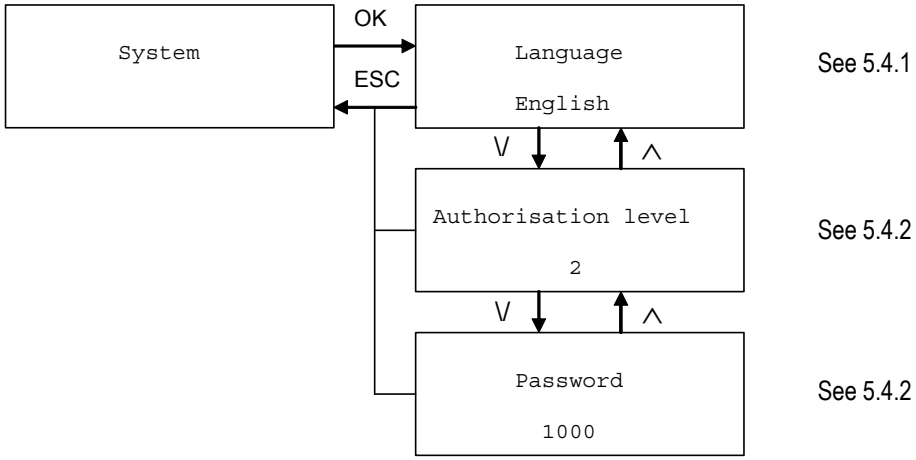
Possible values:

- OFF : no fault output of an external device connected
- D1 : Fault output of external device connected to digital input 1
- D2 : Fault output of external device connected to digital input 2
- D3 : Fault output of external device connected to digital input 3
- D4 : Fault output of external device connected to digital input 4

This function can be used to evaluate the fault relay of an ebm-papst motor:

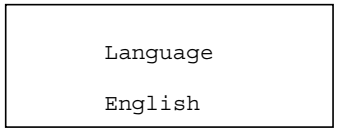
The relay contact is connected to a digital input of the control device.
Select this digital input in the "External fault input" menu.
Then, when a relay contact is opened, a fault is signalled.

5.4 System menu



5.4.1 Language menu

» System > language



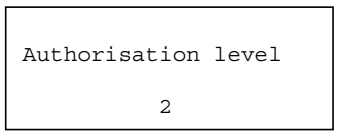
Here, the language can be selected in which all displays appear.

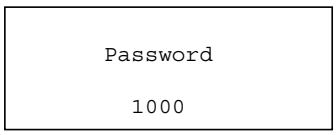
The following languages are possible:

- German
- English (default)
- Swedish

5.4.2 Password function

» System > Authorisation level / Password





The password function controls write access to all parameters in the "Settings", "Alarm functions", "Modbus" and "System" menus. The password function consists of the parameters "Authorisation level" and "Password".

Four authorisation levels are defined:

Authorisation level	Write authorisation
0	No write authorisation
1	Write authorisation for Setpoint > Basic function menu only
2	Write authorisation for all menus except "Holding Register" and "Rot direction source"
3	Write authorisation for all menus

The authorisation level configures write authorisation by default. Thus values can be changed even if the corresponding password has not been entered.

In factory condition, Authorisation level 2 is the default. This allows write authorisation for almost all parameters.

Each authorisation level is assigned a password. The passwords themselves do not form part of this document. These must be requested separately from ebm-papst!
After entering the correct password for an authorisation level, you also obtain the write authorisation for the corresponding authorisation level. However, this does not change the "Authorisation level" parameter.
The additional authorisation via the password input is taken back as soon as a password is entered without authorisation (e.g. 1000).

If no key is pressed on the control device for a 4-minute period, the additional authorisation obtained by the password is withdrawn automatically.
If necessary, re-enter the password then.

Once the menu item password has been selected, the value "1000" always appears, even if a different password has been set. This ensures that unauthorised users are unable to query the correct password from this menu item.

To be able to modify the "Authorisation level" parameter, the password for at least the configured authorisation level must be entered. The "Authorisation level" parameter can then be set no higher than that for which the password is valid.

Example:
Authorisation level 2 is configured
Enter the password for authorisation level 1 → Authorisation level cannot be modified
Enter the password for authorisation level 2 → Authorisation level can be adjusted in the range 0 - 2
Enter the password for authorisation level 3 → Authorisation level can be adjusted in the range 0 - 3

This authorisation procedure ensures the following:

- The password does not have to be entered for each write access if this was not desired.
- No write access is possible that was not permitted by an authorised person.
- The preset authorisation level cannot be downgraded accidentally without knowing the password (otherwise, write access would no longer be possible).

If the input menus on the control device do not respond to the "OK" key being pressed (i.e. the display does not start to flash), write protection is enabled.
In this case, the correct password must be entered in order to enable the input function!

Recommended procedures for setting the password function:

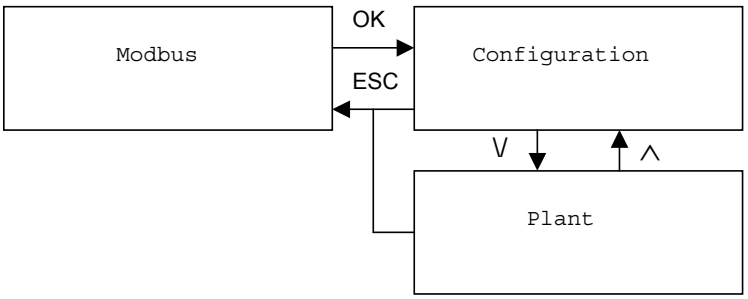
- *Desired function: Each user is to have write access*
  Leave authorisation level at "2" (=factory setting)

- *Desired function: Write authorisation is to exist only if the correct password is entered*
  Enter password for authorisation level 2
  Change authorisation level to 0
  Delete password (enter 1000)

- *Desired function: Write access to parameter "Rot direction source" or Holding Register required*
  Request password for authorisation level 3 from ebm-papst and enter password
  Change authorisation level to 3

6 Modbus

Using the Modbus interface, up to 32 ebm-papst fans can be connected to the control device.
The configuration and data exchange with the fans are carried out in the sub-menu items of "Modbus".

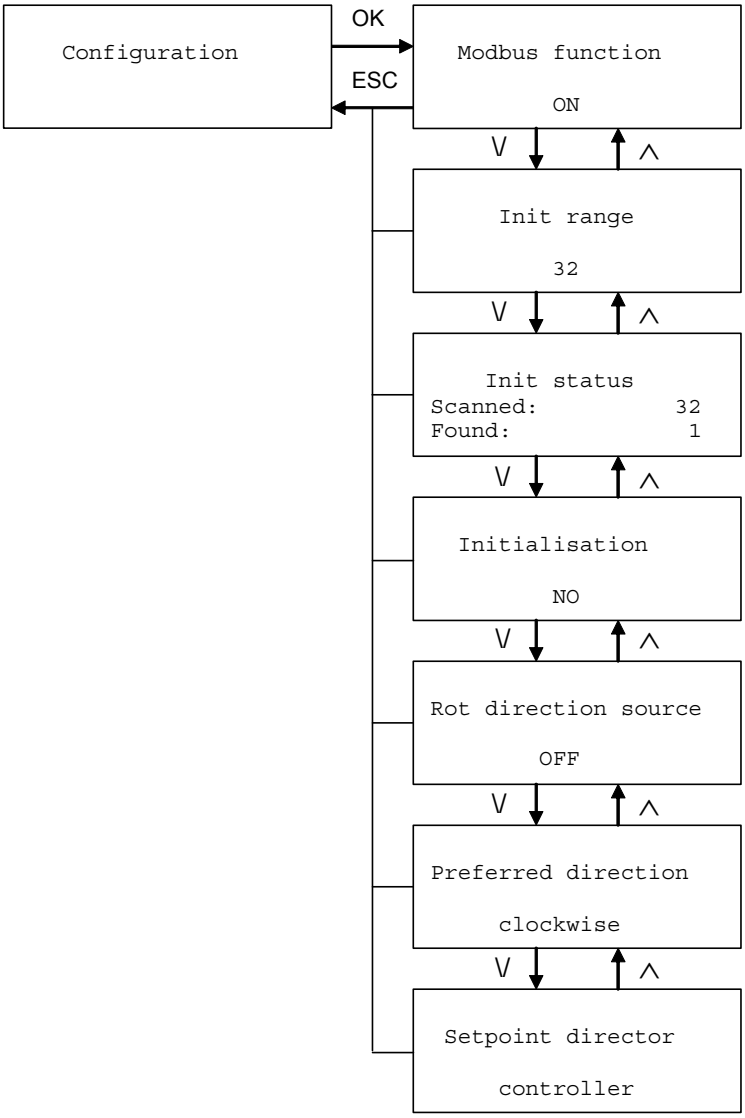


See 6.1

See 6.2

6.1 Configuration menu

Modbus > Configuration



See 6.1.1

See 6.1.2.1

See 6.1.2.2

See 6.1.2.3

See 6.1.3

See 6.1.3

See 6.1.4

6.1.1 Modbus function

Modbus > Configuration > Modbus function

```
Modbus function

        ON
```

The "Modbus function" parameter switches all communication via Modbus on and off.

Possible values:

- ON : Bus function disabled
- OFF : Bus function enabled

Switching on the Modbus function has the following effects:

- Automatic initialisation run (immediately after switching on and after every reset of the device).
- The duty cycle is sent to all fans via broadcast.
- The fault status of all fans found during the initialisation run is checked via a circular query.

If the bus function is not required (i.e. the fans are triggered via 0-10V signal), the Modbus function should be switched off so as not to use up unnecessary computing capacity in the control device.

Then, no signals are output at the Modbus output.

If the Modbus function is inactive, the "Plant" menu (see 6.2) cannot be opened.
The display "Bus inactive" appears there.

6.1.2 Initialization

After the Modbus function is activated and when requested by the user, an initialisation run of the control device is carried out. During this process, the control device searches for fans in the configured address range. Each fan found is displayed in the Plant menu (see 6.2). After 32 fans have been found, the search for more fans is cancelled. No more than these 32 fans are displayed.

After the initialisation run, only the fans that have been found are queried.

After an initialisation run, none of the fans whose connection to the control device was interrupted during the initialisation are displayed!

6.1.2.1 Init range

Modbus > Configuration > Init range

```
Init range

    32
```

The initialisation range specifies the address range in which the search for fans takes place during an initialisation run:
All addresses between 1 and the value specified in the parameter "Init range" are checked.

The wider the Init range selected, the longer an initialisation run takes.
At the maximum value, 247, the initialisation run can take up to 70 seconds.
During the initialisation run, the entire operation of the control device in the "Modbus" menu is blocked. Therefore, select an Init range that is as small as possible in order to minimise the time for an initialisation run.

6.1.2.2 Init status

Modbus > Configuration > Init status

```
    Init status
Scanned:          32
Found:             1
```

The initialisation status (Init status) specifies how many fan addresses have been queried during an initialisation run and how many fans have been found.
No input option exists in this menu item.

In the entire "Modbus" menu, only the menu item "Init Status" is displayed during an initialisation run. The control device cannot be operated during this time.

6.1.2.3 Manual initialization

Modbus > Configuration > Initialization

```
   Initialization

         NO
```

Possible values:

- NO : No manual initialisation
- YES : Trigger manual initialisation

Changing the value to "YES" triggers a manual initialisation:
The search for fans takes place in the configured initialisation range (see 6.1.2.1). Only the fans found during this operation are displayed after the initialisation run.
After the initialisation process is finished, the value is reset to "NO" automatically.

6.1.3 Direction of rotation

≫ Modbus > Configuration > Rot direction source / Preferred direction

Rot direction source
D1

Preferred direction
clockwise

The direction of rotation of the fans is configured using the parameters "Rot direction source" and "Preferred direction".

Possible values for "Preferred direction":

- counter clockwise
- clockwise

Possible values for "Rot direction source":

- OFF : Fans rotate in the direction programmed in the fan; no direction specified by control device
- Preferred : Fans rotate in preferred direction
- D1 : Digital input D1 = open : Fans rotate in preferred direction
  Digital input D1 = GND : Fans rotate opposite to the preferred direction
- D2 : Digital input D2 = open : Fans rotate in preferred direction
  Digital input D2 = GND : Fans rotate opposite to the preferred direction
- D3 : Digital input D3 = open : Fans rotate in preferred direction
  Digital input D3 = GND : Fans rotate opposite to the preferred direction
- D4 : Digital input D4 = open : Fans rotate in preferred direction
  Digital input D4 = GND : Fans rotate opposite to the preferred direction

If the specified direction of rotation changes (by changing one of these parameters or by a status change at a digital input), the duty cycle is first set to 0% for 30 seconds to give the fans time to stop.
Then, the direction of rotation of the fans is changed and they are restarted.

Modifying the parameter "Rot direction source" requires authorisation level 3!

For some applications, it is helpful when during operation opposite the preferred direction, a fixed duty cycle is always specified by the control device.
The prerequisite for this is that the direction of rotation is switched via a digital input.

In this case, the parameters for manual mode must be configured as follows (see 5.2.5):

- Manual mode activation: Select the same digital input as in Rot direction source
- Manual mode source: Internal
- Manual mode speed: Desired duty cycle for operation opposite the preferred direction

6.1.4 Setpoint director

Modbus > Configuration > Setpoint director

Setpoint director Controller

Possible values:

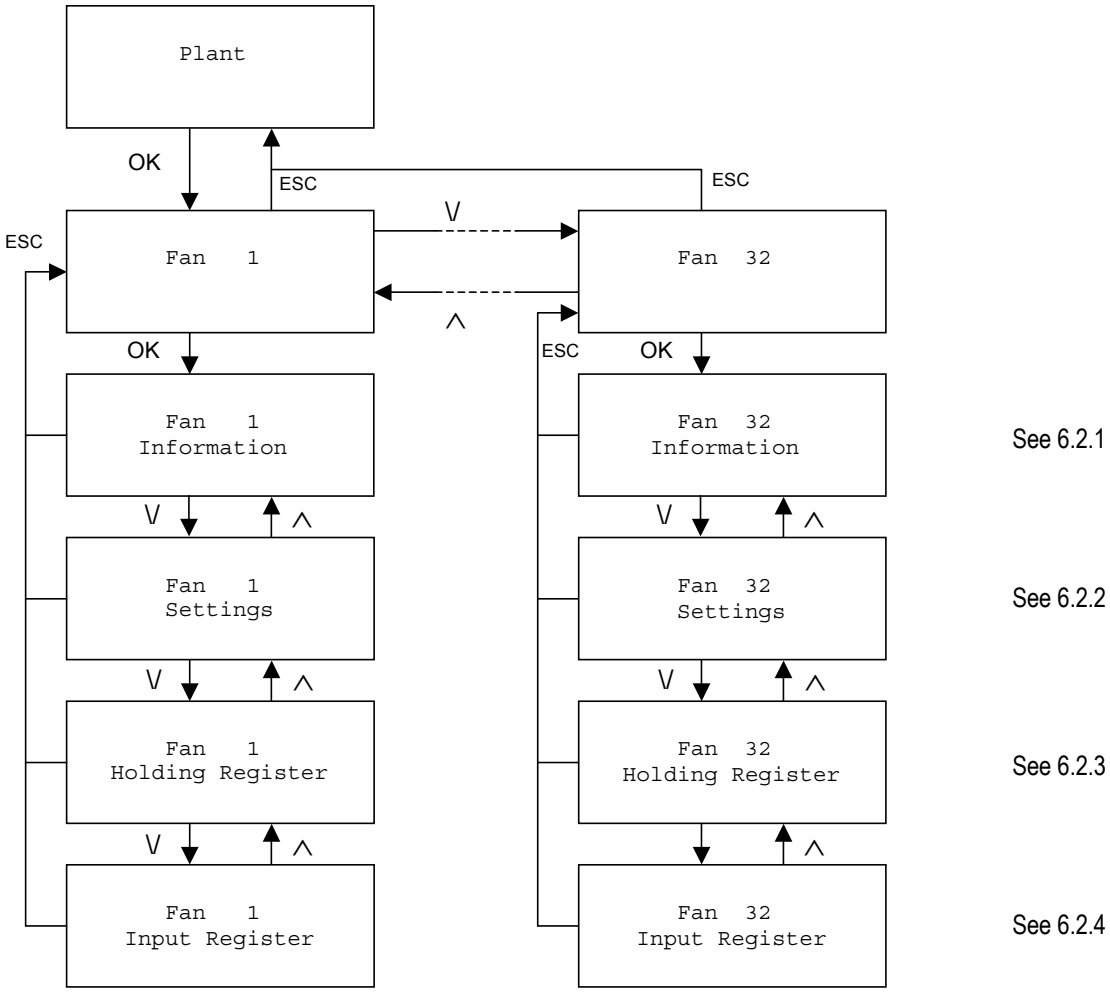
- controller
- Manual

If you select "Controller", the duty cycle calculated by the controller is transmitted periodically to all fans via broadcast.

If you select "Manual", you can specify the duty cycle for each fan individually:
(menu: Modbus > Plant > Fan > Settings > Setpoint, see 6.2.2.3)
In doing so, the duty cycle is transmitted to the fan only once, when a new setpoint is entered.
The duty cycle calculated by the controller is not transmitted to the fans (i.e. the control function is inactive at that time).
The control device then has a similar function to "EC Control" (monitoring software for PC) or "Fan Control" (monitoring software for PDA), but with a greatly limited range of function compared to these programs.

6.2 Plant menu

Modbus > Plant



The Plant menu contains a menu item for each fan found during the initialisation run (specifying the address of the respective fan). Thus the number of menu items can vary between 0 and 32.

If no fan was found during the initialisation run, the following display appears in the Plant menu:

```
      Plant

No fan found
```

The fan menus can then not be activated.

If the Modbus function is inactive (see 6.1.1), the following display appears in the Plant menu:

```
      Plant

   Bus inactive
```

The fan menus can then not be activated.

All values in the "Plant" menu are stored in the corresponding fan only.
If the connection between the control device and fan is interrupted, a question mark (?) appears instead of the value.

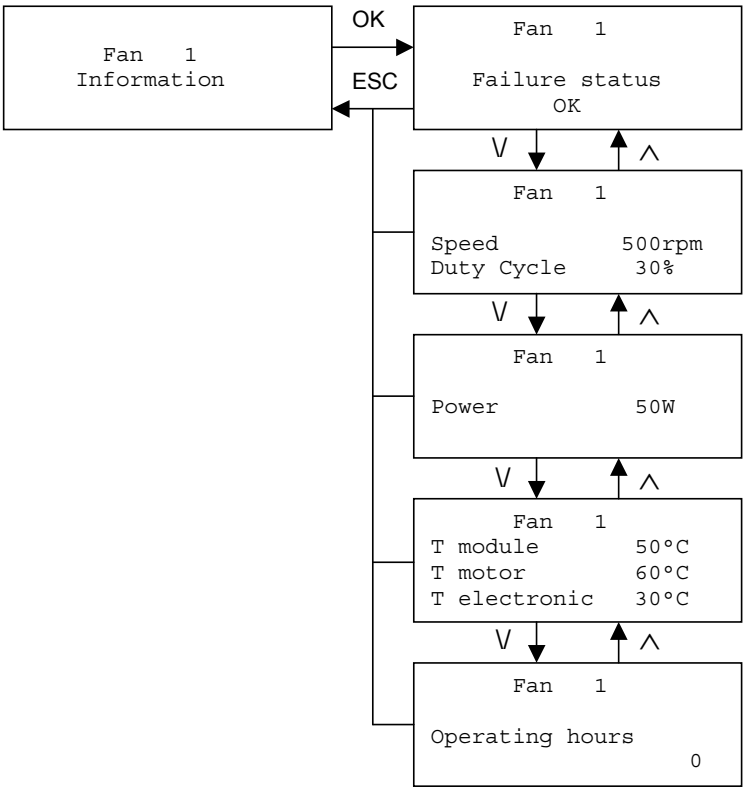
For all connected fans, ensure that the configuration of their Modbus parameters is configured to the control device.
Otherwise, the proper interaction between the control device and fan is not guaranteed.

Specifically, ensure that the following Holding Registers are set correctly:

- D101 Setpoint source — Value: 0001 (RS485)
- D103 Save setpoint — Value: 0000 (do not save setpoint)
- D106 Daytime operating mode — Value: 0002 (control)
- D107 Nighttime operating mode — Value: 0002 (control)

6.2.1 Information Menu

Modbus > Plant > Fan > Information



See 6.2.1.1

See 6.2.1.2

See 6.2.1.3

See 6.2.1.4

See 6.2.1.5

In the Information menu, there is no write access to the data.
The values can be displayed only.

6.2.1.1 Failure status

Modbus > Plant > Fan > Information > Failure status

```
      Fan   1

   Failure status
        OK
```

The failure status specifies the status of the respective fan and a possible cause of the fault:

Possible values:

• OK	
• Phase failure	
• Power module overheated	
• Internal comm error	(communication error between the microcontrollers in the fan)
• Motor overheated	
• Hall sensor failure	
• Locked motor	
• Electronics overheated	
• Overvoltage	
• Undervoltage	
• Reversed operation	(external drive in reversed operation at high speed for longer period)
• Not connected	(RS-485 connection between control device and fan is interrupted)

If an error is displayed without further information ("Error No. ..."), it was not yet defined at the time the control device was developed and thus cannot be output in plain text.
If this display appears, refer to the corresponding "Modbus parameter specification" of the fan to determine the cause of the fault.

6.2.1.2 Speed / duty cycle

Modbus > Plant > Fan > Information > Speed / Duty Cycle

```
      Fan   1

Speed          500rpm
Duty Cycle      30%
```

The current speed of the fan and its duty cycle are displayed.

6.2.1.3 Power

Modbus > Plant > Fan > Information > Power

```
      Fan   1

Power           50W
```

The current power input of the fan is displayed.

6.2.1.4 Temperatures

Modbus > Plant > Fan > Information > Temperatures

```
      Fan    1
T module       50°C
T motor        60°C
T electronic   30°C
```

Various temperatures of the fan are displayed:

- T module : Temperature of the output stage module
- T motor : Temperature of the motor winding
- T electronic : Temperature of the electronics interior compartment

If the corresponding temperature sensor is not present in the fan, no value (---) is displayed for this temperature.

6.2.1.5 Operating hours

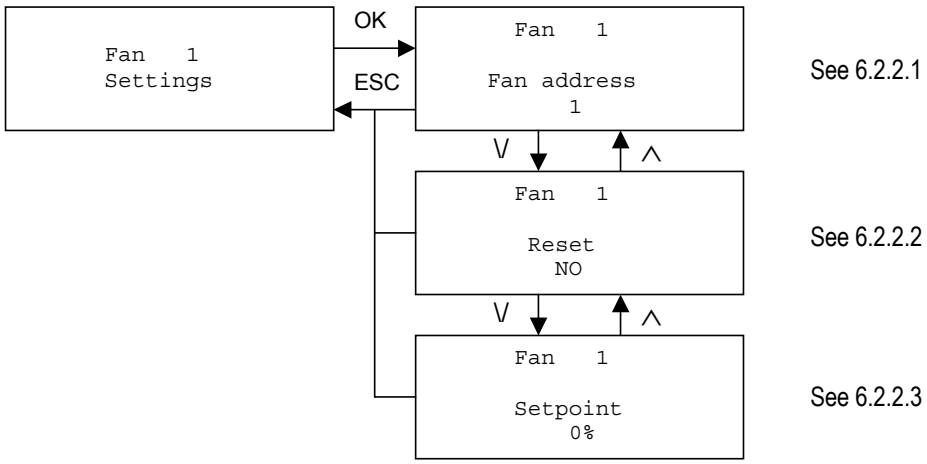
Modbus > Plant > Fan > Information > Operating hours

```
      Fan   1

Operating hours
                  0
```

The operating hours of the *Fan* are displayed.

6.2.2 Settings menu

Modbus > Plant > Fan > Settings



See 6.2.2.1

See 6.2.2.2

See 6.2.2.3

In the "Settings" menu, the values can be both read and modified.

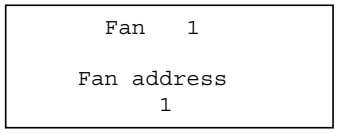
If a value in the fan could not be modified correctly, the message "Write access error" is displayed.

Possible causes of the fault:

- The connection between the control device and fan is interrupted.
- Faults on the bus line.
- The fan power supply is interrupted.
- When the fan address is changed: A fan with the desired address already exists in the network.

6.2.2.1 Fan address

Modbus > Plant > Fan > Settings > Fan address



You can change the Modbus address of the fan here.

After a fan address is changed, the fan can no longer be reached at its old address. Therefore, no more values can be displayed in any of the fan's menu items. Instead of the values, a question mark (?) appears.

An initialisation run is required to display the fan (see 6.1.2). After the initialisation run, the fan appears under its new address in the "Plant" menu.

Only fan addresses that do not already exist in the network may be selected.
If, despite this, you select an address that is already assigned in the network, the "Write access error" message is displayed. The fan address is not changed!

Procedure for setting up a plant:

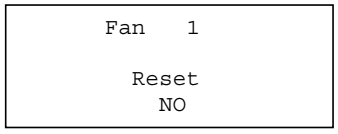
All ebm-papst fans are delivered from the factory with the fan address 1. Therefore, when connecting multiple fans to a control device, the fan address must be reassigned for each fan.

We recommend following this procedure:

- Connect *one* fan to the network and switch it on.
- Start the initialisation run on the control device: In the Plant menu, a fan appears with the address "1".
- Change the fan address to the value "2": The fan is then no longer accessible (question mark appears in the display) You do not need to carry out another initialisation run for the time being.
- Connect the next fan to the network and switch it on. This fan also has fan address 1 and can be reached at this address. To obtain a valid display, you have to exit the "Fan address" menu briefly.
- Change the fan address to the value of "3"
- After this procedure, connect one fan after another to the network. When doing so, increase the fan address by 1 for each fan.
- Connect the last fan to the network. You can leave this fan at the address "1".
- Start the initialisation run: All fans appear in the "Plant" menu.

6.2.2.2 Reset

Modbus > Plant > Fan > Settings > Reset



If the value is changed to "YES", a reset in the fan is triggered. This causes a defined restart of the firmware *in the fan*. After the reset process in the fan is finished, the value is set to "NO" automatically.

Application:

If there is a fault in the fan (see 6.2.1.1), it can be cleared by a reset only. The fan cannot restart until the fault has been reset.

If the cause of the fault is not eliminated, the fault can reappear immediately after the reset.

6.2.2.3 Setpoint

Modbus > Plant > Fan > Settings > Setpoint

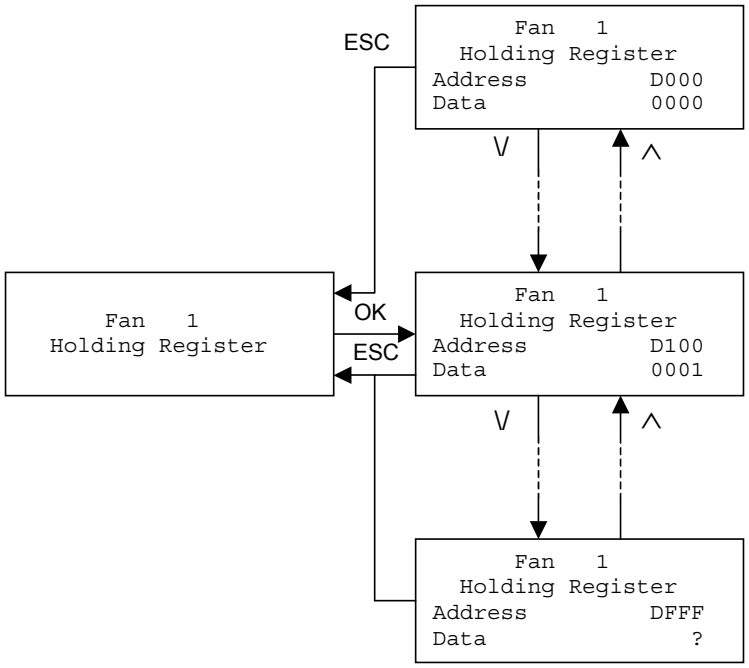
```
Fan   1

Setpoint
    0%
```

Here, you can assign each fan an individual setpoint for the duty cycle.

This menu is active only if the value "Manual" is configured in the Setpoint director menu (see 6.1.4). Otherwise, no value (---) appears and there is also no input option.

6.2.3 Holding Register

Modbus > Plant > Fan > Holding Register



In the "Holding Register" menu item, the values of all Holding Registers of a fan can be displayed and modified in a range between D000 and DFFF. This is the address range in which all Holding Registers of ebm-papst fans typically lie. All values are displayed in hexadecimal format.

Because the control device displays only very few Holding Registers of a fan in plain text (Fan address, Reset, Setpoint), this menu provides an opportunity to check the configuration of the fan and change it if necessary.

The Holding Register area contains a total of 4096 sub-menus (one for each Holding Register address between D000 and DFFF). To enable quick toggling between the individual menu items, the address of the individual menu items can be changed quickly by holding the ▼ or ▲ button (similar to the fast mode function when editing data).

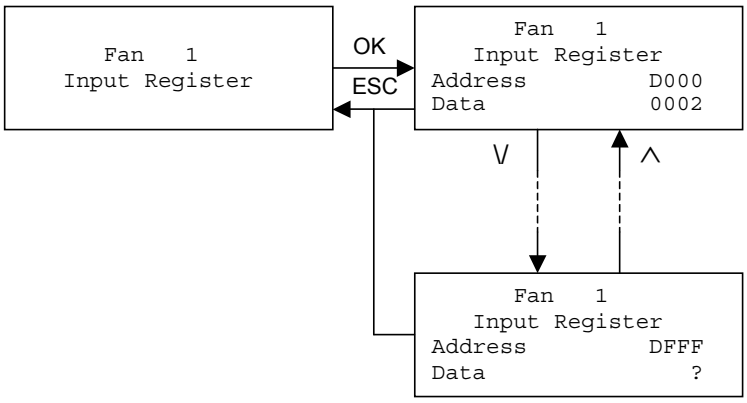
For the function of the Holding Registers, refer to the "Modbus parameter specification for ebm standard series".

Modifying the data of a Holding Register requires authorisation level 3!

Holding Registers for which the Modbus authorisation "Customer" or "ebm-papst" is necessary can be changed only if the required password value has been entered previously in the "Password" (D002 - D004) Holding Register. Otherwise, write access is denied.

6.2.4 Input Register

Modbus > Plant > Fan > Input Register



In the "Input Register" menu item, the values of all Input Registers of a fan can be displayed and modified in a range between D000 and DFFF. This is the address range in which all Input Registers of ebm-papst fans typically lie. All values are displayed in hexadecimal format.

Because the control device displays only very few Input Registers of a fan in plain text, this menu provides an opportunity to check the configuration of the fan and change it if necessary.

The Input Register area contains a total of 4096 sub-menus (one for each Input Register address between D000 and DFFF). To enable quick toggling between the individual menu items, the address of the individual menu items can be changed quickly by holding the ▼ or ▲ button (similar to the fast mode function when editing data).

For the function of the Input Registers, refer to the "Modbus parameter specification for ebm standard series".

7 Preset operating modes

A simple installation of the control device can be achieved by selected pre-programmed operating modes. Selection is made via the menu item Operating mode > Operating mode 1.
When selecting application-specific operating modes, configuration of the "Settings" and "Alarm functions" menus is performed automatically, i.e. all values in these menus are overwritten with the preset values.
The factory pre-settings for each operating mode are based on experiential figures compiled over many years and suitable for many different applications. In exceptional cases, these can be adapted individually by manually changing the figures in the "Settings" and "Alarm functions" menus.

7.1 Temperature control

7.1.1 Temperature control, standard

Application:

Temperature control, climate and refrigeration technology.

Parameters:

Parameter	Pre-setting	Customer setting ✍
Operating mode	T01	
Sensor type E1	Temperature sensor KTY 10-6	
Signal form E1	PTC	
Unit E1	°C	
Decimal places E1	1	
Measuring range E1 min	-30.0	
Measuring range E1 max	70.0	
Sensor comparison check E1	0.0	
Sensor type E2	No sensor	
Signal form E2	OFF	
Unit E2	Pa	
Decimal places E2	0	
Measuring range E2 min	0	
Measuring range E2 max	1000	
Sensor comparison check E2	0	
Setpoint 1	20.0	
Switchover, setpoint 1/2	OFF	
Setpoint 2	20.0	
Setpoint reduction	OFF	
Setpoint reduct. Start	15	
Setpoint reduct. End	-15	
Setpoint at endpoint	70.0	
Control funct source	Internal	
Control function	Cooling	
Control range	5.0	
P - Factor	2000%	
I - Factor	0.0%	
Actual value source	E1	
On/Off speed	0%	
Follow-up time	0s	
Min. speed	0%	

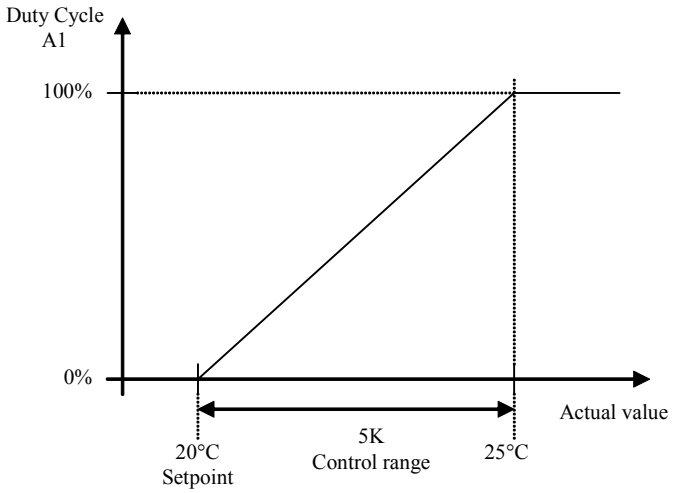
Parameter	Pre-setting	Customer setting ✍
Max. speed	100%	
Remote enable	OFF	
Boost mode	OFF	
Manual mode activation	OFF	
Manual mode source	Internal	
Man. mode Duty Cycle	0%	
Night limitation activation	OFF	
Max. night duty cycle	100%	
Minimum air shutdown	OFF	
Shutdown control deviation	0.0	
Hysteresis	0.0	
Function K1	All faults	
Active state K1	opened	
On-delay K1	0s	
Drop-out delay K1	0s	
Function K2	Off / static	
Active state K2	opened	
On-delay K2	0s	
Drop-out delay K2	0s	
Screen display sensor fault	OFF	
External fault input	OFF	

Sensor:

Type	: Temperature sensor KTY-10-6; R25 = 2kΩ
Connection	: Input temperature sensor 1 (terminal strip 3; terminal 1 + 2)

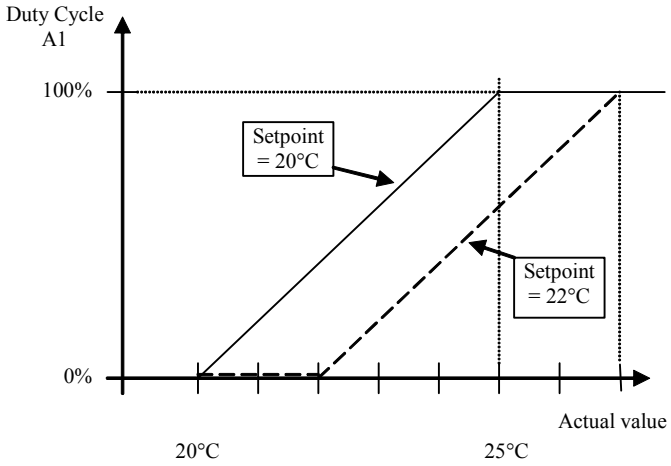
Control:

If the parameters are not changed, the following control behaviour results (P - controller):

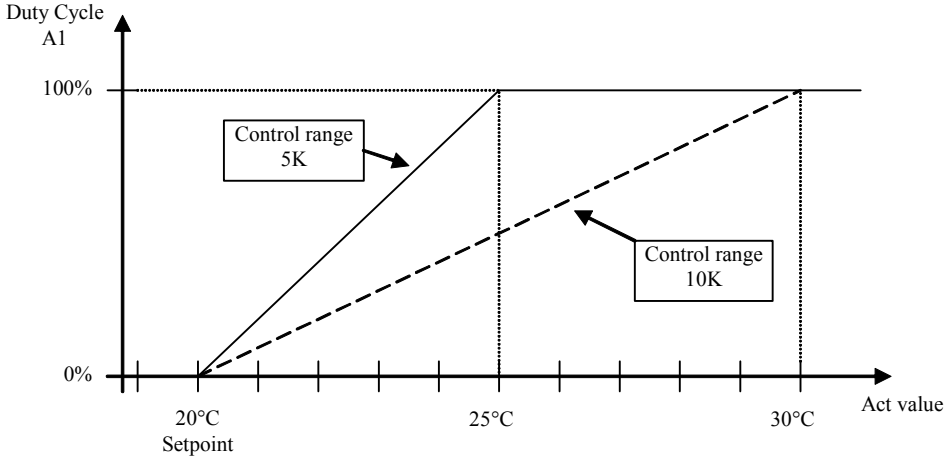


Frequent modifications:

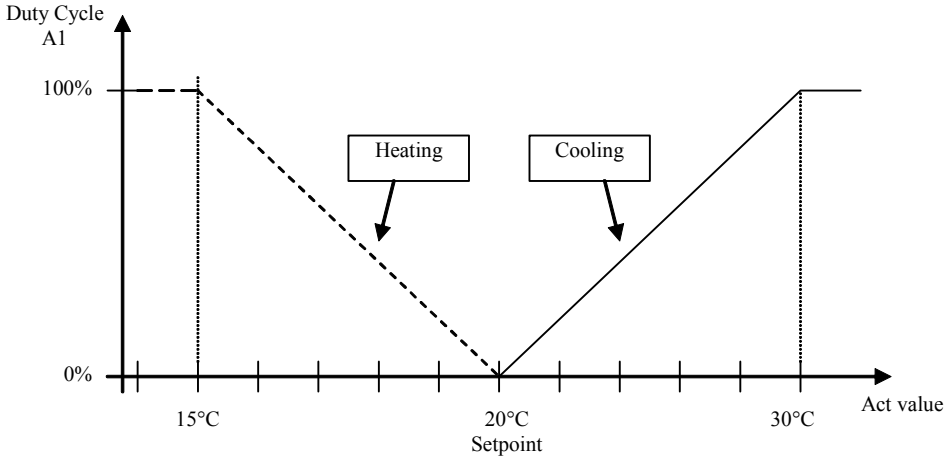
a) Change in setpoint:



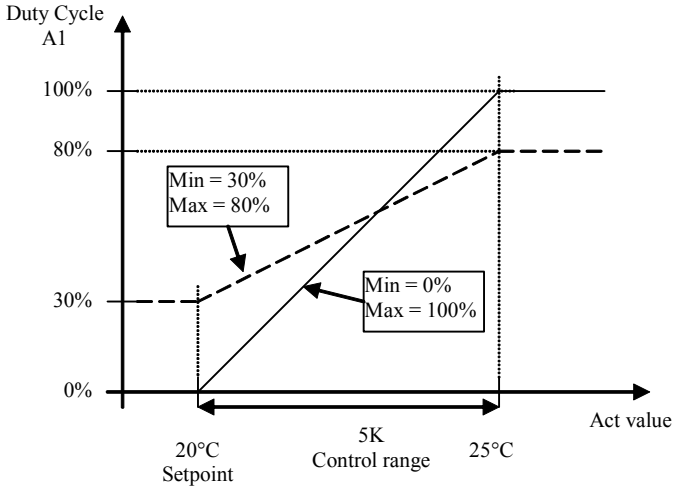
b) Change in control range



c) Change in control function



d) Change in Fan level A1 (min. speed; max. speed)



7.1.2 NTC temperature control

Application:

Temperature control of air-conditioning and refrigeration systems for applications that require an NTC as the temperature sensor.

Parameters:

Parameter	Pre-setting	Customer setting ✍
Operating mode	T02	
Sensor type E1	Temperature sensor NTC 103AT	
Signal form E1	NTC	
Unit E1	°C	
Decimal places E1	1	
Measuring range E1 min	-30.0	
Measuring range E1 max	90.0	
Sensor comparison check E1	0.0	
Sensor type E2	No sensor	
Signal form E2	OFF	
Unit E2	Pa	
Decimal places E2	0	
Measuring range E2 min	0	
Measuring range E2 max	1000	
Sensor comparison check E2	0	
Setpoint 1	20.0	
Switchover, setpoint 1/2	OFF	
Setpoint 2	20.0	
Setpoint reduction	OFF	
Setpoint reduct. Start	15	
Setpoint reduct. End	-15	
Setpoint at endpoint	70.0	
Control funct source	Internal	
Control function	Cooling	

Parameter	Pre-setting	Customer setting ✍
Control range	5.0	
P - Factor	2400%	
I - Factor	0.0%	
Actual value source	E1	
On/Off speed	0%	
Follow-up time	0s	
Min. speed	0%	
Max. speed	100%	
Remote enable	OFF	
Boost mode	OFF	
Manual mode activation	OFF	
Manual mode source	Internal	
Man. mode Duty Cycle	0%	
Night limitation activation	OFF	
Max. night duty cycle	100%	
Minimum air shutdown	OFF	
Shutdown control deviation	0.0	
Hysteresis	0.0	
Function K1	All faults	
Active state K1	opened	
On-delay K1	0s	
Drop-out delay K1	0s	
Function K2	Off / static	
Active state K2	opened	
On-delay K2	0s	
Drop-out delay K2	0s	
Screen display sensor fault	OFF	
External fault input	OFF	

Sensor:

Type	: Temperature sensor NTC 103AT; R25 = 10kΩ
Connection	: Input for temperature sensor 3 (terminal strip 3; terminals 29 + 30)

The NTC 103AT has a larger component tolerance than the KTY10-6.
If it is not necessary to use an NTC as the temperature sensor, we therefore recommend using the KTY 10-6 as a sensor. Please refer to 7.1.1.

Control:

The control behaviour corresponds to that of the "Temperature control, standard" operating mode.
For additional information, refer to 7.1.1.

7.2 Pressure control

7.2.1 Pressure control, ventilation systems

Application:

Pressure control for ventilation systems in HVAC technology

Parameters:

Parameter	Pre-setting	Customer setting ✍
Operating mode	P01	
Sensor type E1	Pressure sensor 0..500Pa	
Signal form E1	0-10V	
Unit E1	Pa	
Decimal places E1	0	
Measuring range E1 min	0	
Measuring range E1 max	500	
Sensor comparison check E1	0	
Sensor type E2	No sensor	
Signal form E2	OFF	
Unit E2	Pa	
Decimal places E2	0	
Measuring range E2 min	0	
Measuring range E2 max	1000	
Sensor comparison check E2	0	
Setpoint 1	250	
Switchover, setpoint 1/2	OFF	
Setpoint 2	250	
Setpoint reduction	OFF	
Setpoint reduct. Start	15	
Setpoint reduct. End	-15	
Setpoint at endpoint	70	
Control funct source	Internal	
Control function	Heating	
Control range	1000	
P - Factor	50%	
I - Factor	5.0%	
Actual value source	E1	
On/Off speed	12%	
Follow-up time	20s	
Min. speed	0%	
Max. speed	100%	
Remote enable	OFF	
Boost mode	OFF	
Manual mode activation	OFF	
Manual mode source	0%	
Man. mode Duty Cycle	Internal	
Night limitation activation	OFF	
Max. night duty cycle	100%	
Minimum air shutdown	OFF	
Shutdown control deviation	0	
Hysteresis	0	
Function K1	All faults	
Active state K1	opened	
On-delay K1	0s	

Parameter	Pre-setting	Customer setting ✍
Drop-out delay K1	0s	
Function K2	Off / static	
Active state K2	opened	
On-delay K2	0s	
Drop-out delay K2	0s	
Screen display sensor fault	OFF	
External fault input	OFF	

Sensor:

Type : Pressure sensor 0..500Pa -> 0..10V
Connection : Input 0..10V (1) (terminal strip 3; terminals 9 + 10)

Control:

Using the I - Factor the system controls pressure in such a way that the setpoint is always reached (Actual value = Setpoint).
For this reason, it is not possible to depict the "Duty Cycle" as a function of the actual value.

A setpoint of 250Pa is factory-set.
This means that the actual value in fully modulated status is also 250Pa.

The control parameters are set to the following default values:

- P - Factor : 50%
- I - Factor : 5%

These values are sufficient for most applications.

The "Control range" parameter as another display form for the P - Factor does not indicate anything since it is controlled by the I - Factor throughout this range.

As a control function for this application, only the "Heating" setting (i.e. positive operating direction) is meaningful. The "Cooling" setting (negative operating direction) always culminates in an unstable system!

Modifications:

a) Change in setpoint:

Often the user requires a different setpoint to the standard one.
After each change in setpoint, the device controls the actual value to the new setting.

b) Change to control parameters

If the control system starts to oscillate with the standard values, the control parameters should be reduced. The setpoint is then reached more slowly and the feedback control function is more stable.

If the control system does not modulate the value fast enough, then the control parameters should be increased.
The setpoint is reached faster. However, in this case, there is a higher probability of unstable behaviour occurring.

The optimum setting is always dependent on the control path (user system)!

7.2.2 Pressure control, ambient temperature-compensated

Application:

Pressure control for ventilation systems in HVAC technology.
The setpoint is altered proportionally to the ambient temperature.

Parameters:

Parameter	Pre-setting	Customer setting ✍
Operating mode	P02	
Sensor type E1	Pressure sensor 0..500Pa	
Signal form E1	0-10V	
Unit E1	Pa	
Decimal places E1	0	
Measuring range E1 min	0	
Measuring range E1 max	500	
Sensor comparison check E1	0	
Sensor type E2	Temperature sensor KTY 10-6	
Signal form E2	PTC	
Unit E2	°C	
Decimal places E2	1	
Measuring range E2 min	-30.0	
Measuring range E2 max	70.0	
Sensor comparison check E2	0.0	
Setpoint 1	250	
Switchover, setpoint 1/2	OFF	
Setpoint 2	250	
Setpoint reduction	ON	
Setpoint reduct. Start	15.0	
Setpoint reduct. End	-15.0	
Setpoint at endpoint	70	
Control funct source	Internal	
Control function	Heating	
Control range	1000	
P - Factor	50%	
I - Factor	5.0%	
Actual value source	E1	
On/Off speed	12%	
Follow-up time	20s	
Min. speed	0%	
Max. speed	100%	
Remote enable	OFF	
Boost mode	OFF	
Manual mode activation	OFF	
Manual mode source	Internal	
Man. mode Duty Cycle	0%	
Night limitation activation	OFF	
Max. night duty cycle	100%	
Minimum air shutdown	OFF	
Shutdown control deviation	0	
Hysteresis	0	
Function K1	All faults	
Active state K1	opened	

Parameter	Pre-setting	Customer setting ✍
On-delay K1	0s	
Drop-out delay K1	0s	
Function K2	Off / static	
Active state K2	opened	
On-delay K2	0s	
Drop-out delay K2	0s	
Screen display sensor fault	OFF	
External fault input	OFF	

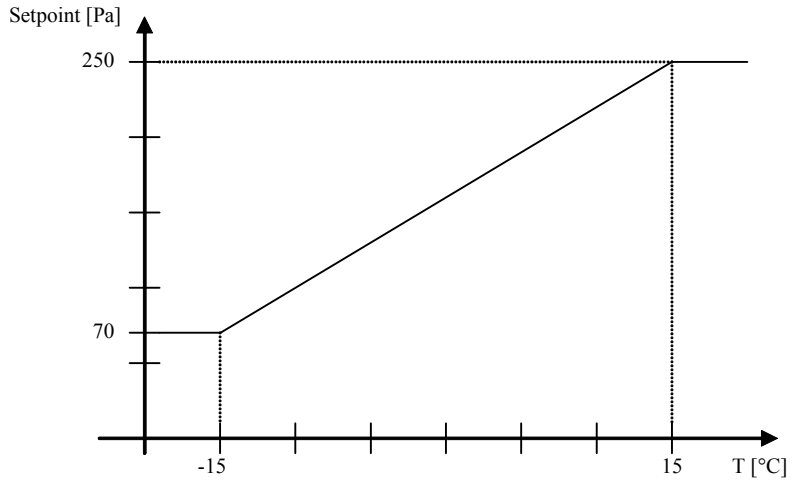
Sensors:

Type : Pressure sensor 0..500Pa -> 0..10V
Connection : Input 0..10V (1) (terminal strip 3; terminals 9 + 10)

Type : Temperature sensor KTY-10-6; R25 = 2kΩ
Connection : Input for temperature sensor 2 (terminal strip 3; terminals 3 + 4)

Setpoint adjustment dependent upon ambient temperature:

The factory-configured setpoint of 250Pa is adjusted in accordance with the ambient temperature in the following manner:



For T ≥ 15°C : Setpoint = 250Pa
For -15°C ≤ T < 15°C : Setpoint of basic function is altered in linear fashion within range [70Pa...250Pa]
For T < -15°C : Setpoint = 70Pa

Control:

Control is identical to 7.2.1 Pressure control of ventilation systems.
Operating method: refer to this Chapter.

Modifications:

a) Change in control parameters

If the control system starts to oscillate with the standard values, the control parameters should be reduced. The setpoint is then reached more slowly and the feedback control function is more stable.

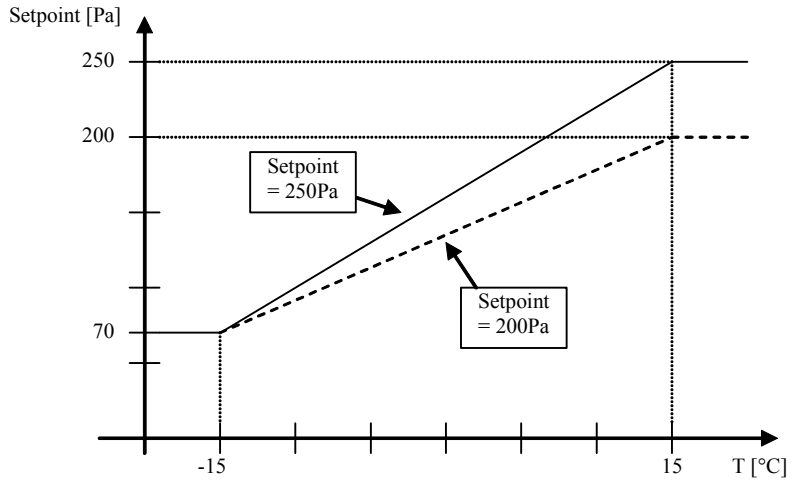
If the control system does not modulate the value fast enough, then the control parameters should be increased.
The setpoint is reached faster. However, in this case, there is a higher probability of unstable behaviour occurring.

The optimum setting is always dependent on the control path (user system)!

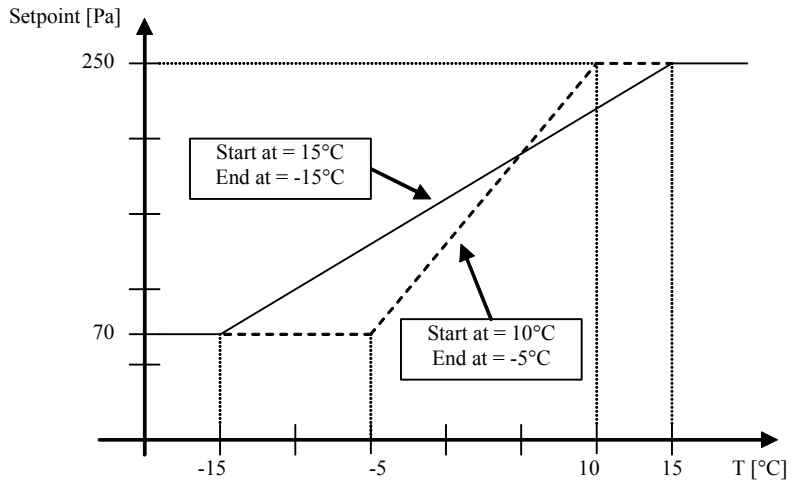
b) Change in setpoint:

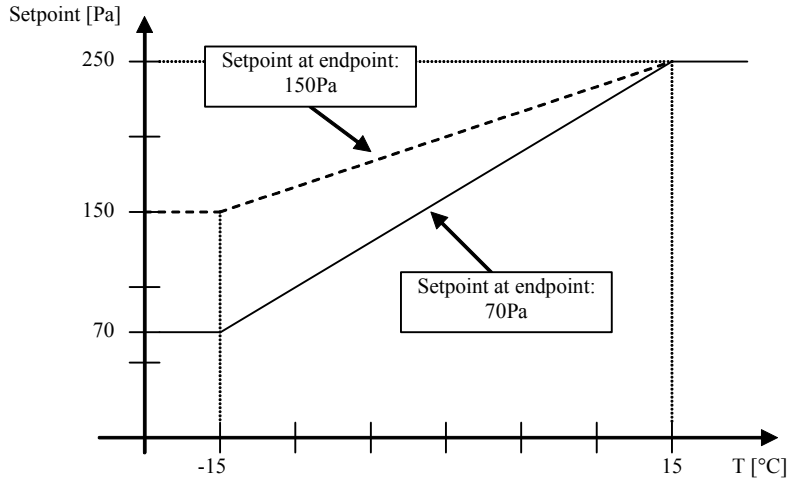
Often the user requires a different setpoint to the standard one.
After each change in setpoint, the device controls the actual value to the new setting.

The setpoint curve is dependent on ambient temperature and changes as follows:



b) Change in parameter for ambient temperature compensation:





7.2.3 Pressure control of condensers

Application:

Pressure control for condensers in refrigeration technology

Parameters:

Parameter	Pre-setting	Customer setting ✍
Operating mode	C01	
Sensor type E1	Pressure sensor 0..30bar	
Signal form E1	4..20mA	
Unit E1	bar	
Decimal places E1	2	
Measuring range E1 min	0	
Measuring range E1 max	30.00	
Sensor comparison check E1	0	
Sensor type E2	No sensor	
Signal form E2	OFF	
Unit E2	Pa	
Decimal places E2	0	
Measuring range E2 min	0	
Measuring range E2 max	1000	
Sensor comparison check E2	0	
Setpoint 1	12.00	
Switchover, setpoint 1/2	OFF	
Setpoint 2	12.00	
Setpoint reduction	OFF	
Setpoint reduct. Start	15	
Setpoint reduct. End	-15	
Setpoint at endpoint	70.00	
Control funct source	Internal	
Control function	Cooling	
Control range	5.00	
P - Factor	600%	
I - Factor	0.0%	
Actual value source	E1	
On/Off speed	0%	
Follow-up time	0s	
Min. speed	0%	
Max. speed	100%	
Remote enable	OFF	
Boost mode	OFF	
Manual mode activation	OFF	
Manual mode source	Internal	
Man. mode Duty Cycle	0%	
Night limitation activation	OFF	
Max. night duty cycle	100%	
Minimum air shutdown	OFF	
Shutdown control deviation	0.00	
Hysteresis	0.00	
Function K1	All faults	
Active state K1	opened	
On-delay K1	0s	

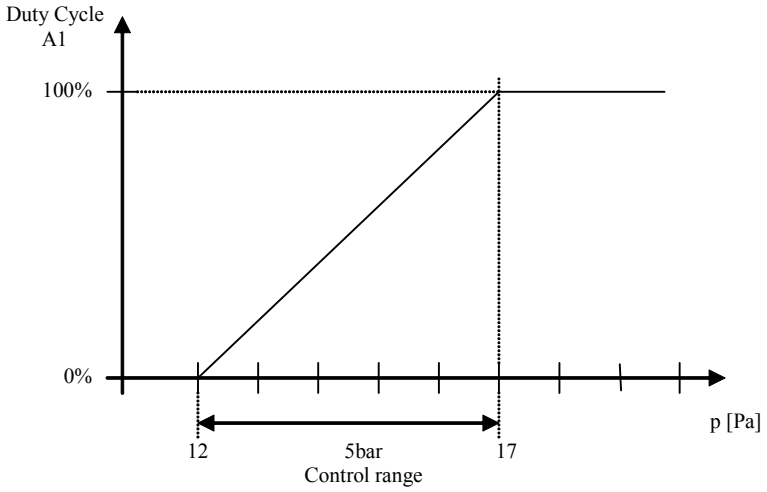
Parameter	Pre-setting	Customer setting ✍
Drop-out delay K1	0s	
Function K2	Off / static	
Active state K2	opened	
On-delay K2	0s	
Drop-out delay K2	0s	
Screen display sensor fault	OFF	
External fault input	OFF	

Sensor:

Type : Pressure sensor 0..30bar -> 4..20mA
Connection : Input 0/4..20mA (1) (terminal strip 3; terminals 6 + 10)

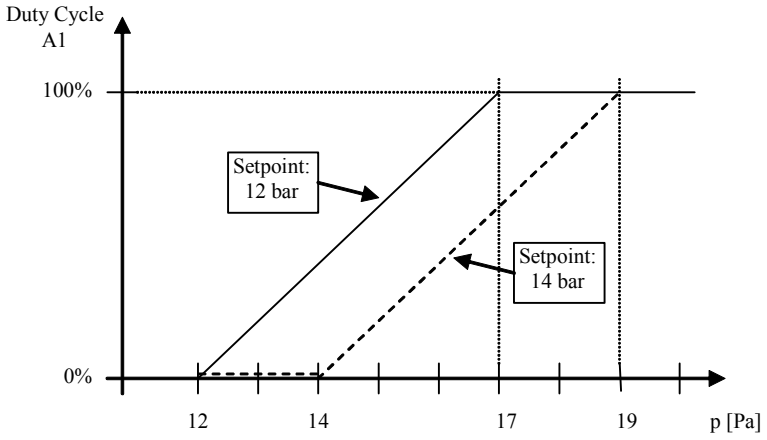
Control:

If the parameters are not changed, the following control behaviour results (P - controller):

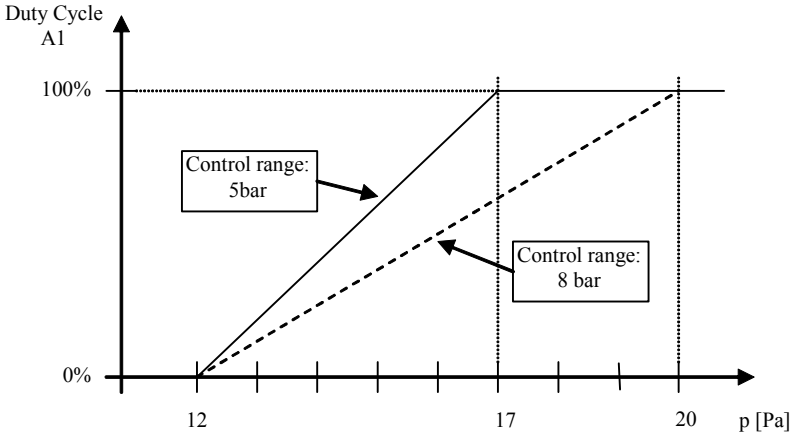


Modifications:

a) Change in setpoint



b) Change in control range



Factory pre-settings must always be adapted by a specialist to suit prevailing plant conditions!

7.2.4 Pressure control, dual-circuit condensers

Application:

Pressure control for dual-circuit condensers in refrigeration technology

Parameters:

Parameter	Pre-setting	Customer setting ✍
Operating mode	C02	
Sensor type E1	Pressure sensor 0..30bar	
Signal form E1	4..20mA	
Unit E1	bar	
Decimal places E1	2	
Measuring range E1 min	0	
Measuring range E1 max	30.00	
Sensor comparison check E1	0	
Sensor type E2	Pressure sensor 0..30bar	
Signal form E2	4..20mA	
Unit E2	bar	
Decimal places E2	2	
Measuring range E2 min	0	
Measuring range E2 max	30.00	
Sensor comparison check E2	0	
Setpoint 1	12.00	
Switchover, setpoint 1/2	OFF	
Setpoint 2	12.00	
Setpoint reduction	OFF	
Setpoint reduct. Start	15.00	
Setpoint reduct. End	-15.00	
Setpoint at endpoint	70.00	
Control funct source	Internal	
Control function	Cooling	
Control range	5.00	
P - Factor	600%	
I - Factor	0.0%	
Actual value source	Max (E1; E2)	
On/Off speed	0%	
Follow-up time	0s	
Min. speed	0%	
Max. speed	100%	
Remote enable	OFF	
Boost mode	OFF	
Manual mode activation	OFF	
Manual mode source	Internal	
Man. mode Duty Cycle	0%	
Night limitation activation	OFF	
Max. night duty cycle	100%	
Minimum air shutdown	OFF	
Shutdown control deviation	0.00	
Hysteresis	0.00	
Function K1	All faults	
Active state K1	opened	
On-delay K1	0s	

Parameter	Pre-setting	Customer setting ✍
Drop-out delay K1	0s	
Function K2	Off / static	
Active state K2	opened	
On-delay K2	0s	
Drop-out delay K2	0s	
Screen display sensor fault	OFF	
External fault input	OFF	

Sensors:

Type : Pressure sensor 0..30bar -> 4..20mA
Connection : Input 0/4..20mA (1) (terminal strip 3; terminals 6 + 10)

Type : Pressure sensor 0..30bar -> 4..20mA
Connection : Input 0/4..20mA (2) (terminal strip 3; terminals 8 + 12)

Control:

The control behaviour corresponds to that of the simple condensers (see 7.2.3)

The difference is that the system has 2 sensors for establishing the actual value.
It controls automatically to the higher actual value for pressure.

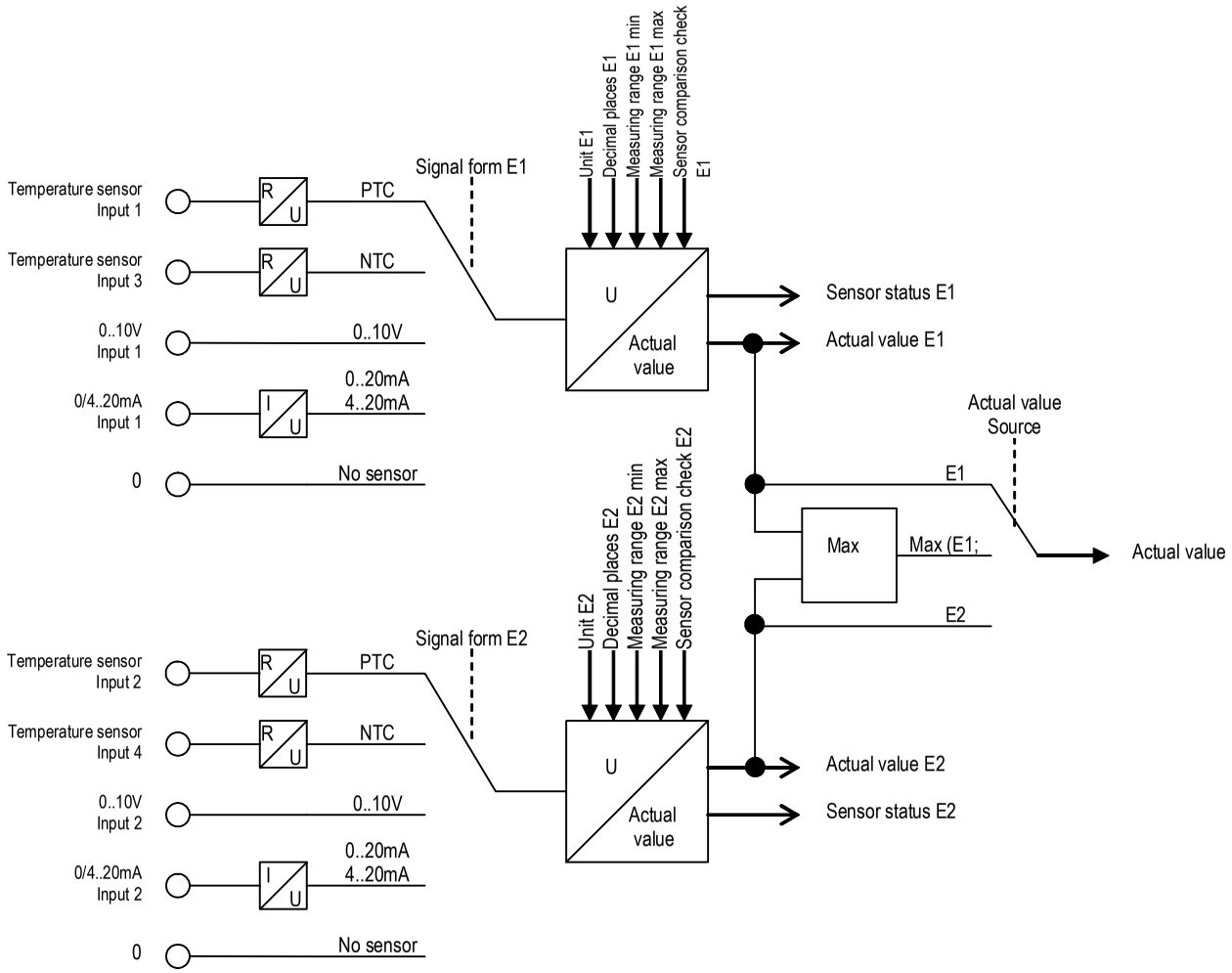
Modifications:

See 7.2.3

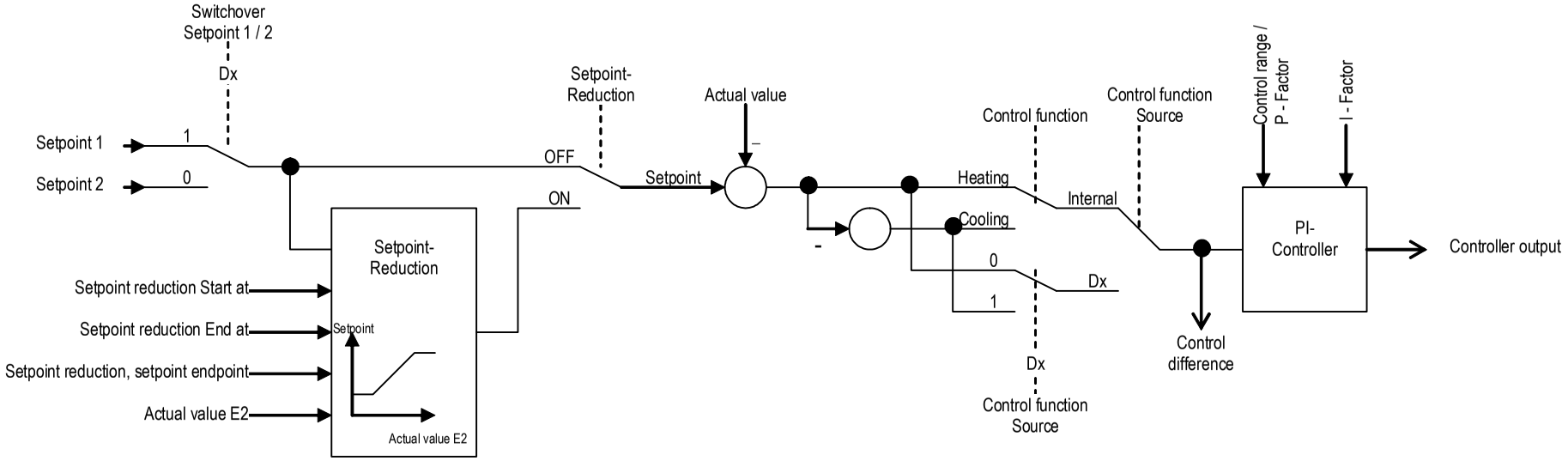
Factory pre-settings must always be adapted by a specialist to suit prevailing plant conditions!

8 Block circuit diagrams for the controller

8.1 Calculating actual values

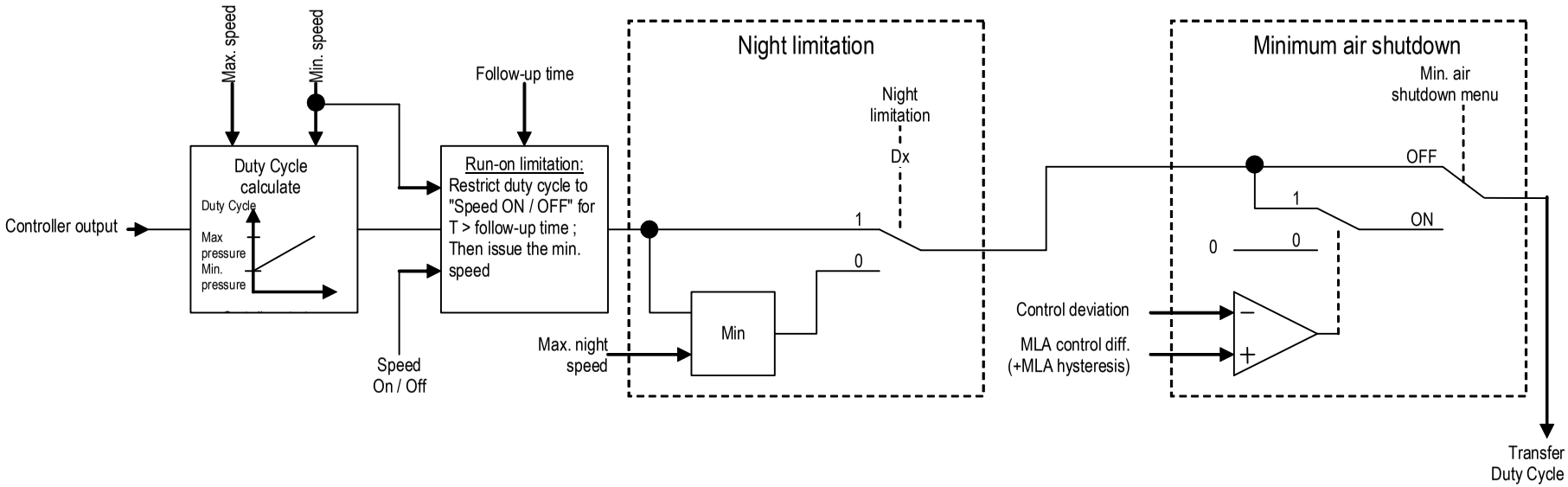


8.2 Calculating setpoints / controller

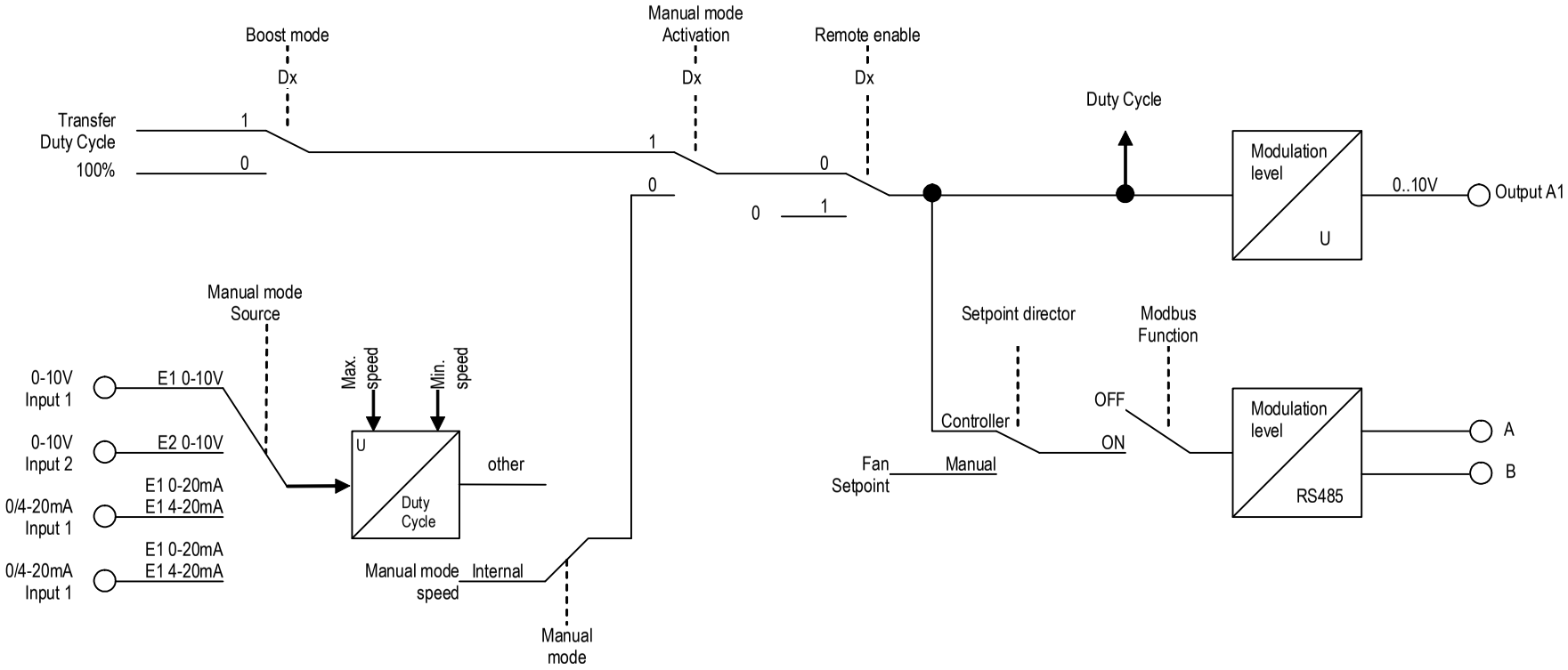


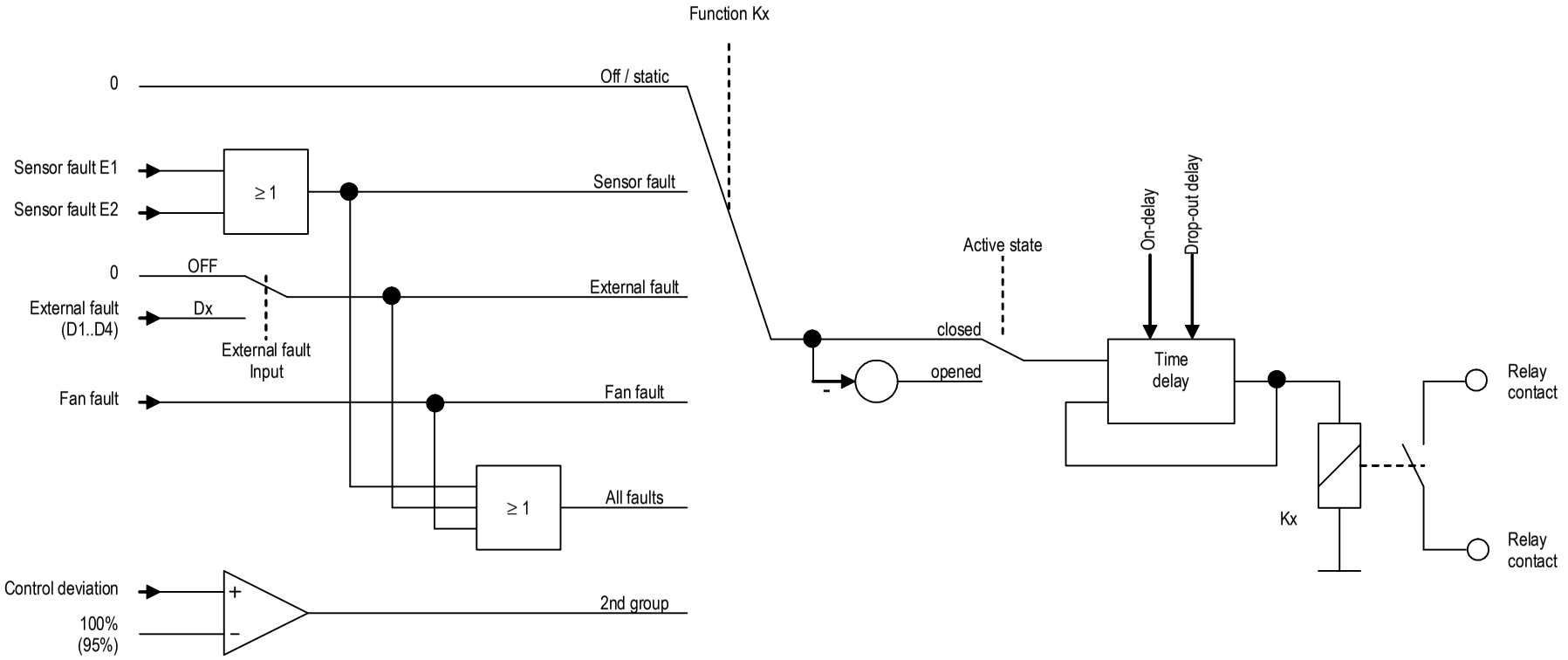
8.3 Calculating duty cycle

Part 1:



Part 2:


Boost mode
Dx
Manual mode
Activation
Dx
Remote enable
Dx
Duty Cycle
Transfer
Duty Cycle
100%
1
0
1
0
0
1
Modulation
level
U
0..10V
Output A1
Manual mode
Source
Setpoint director
Modbus
Function
0-10V
Input 1
E1 0-10V
0-10V
Input 2
E2 0-10V
0/4-20mA
Input 1
E1 0-20mA
E1 4-20mA
0/4-20mA
Input 1
E1 0-20mA
E1 4-20mA
Max.
speed
Min.
speed
U
Duty
Cycle
other
Manual mode
speed
Internal
Manual
mode
Controller
OFF
ON
Fan
Setpoint
Manual
Modulation
level
RS485
A
B

8.4 Relay activation

Activation is identical for both relays K1 and K2: